Quick Freezing Solves Food Problems

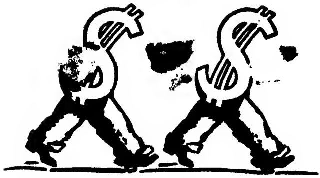
Flying Blind, Guided by Radio • Amateur Archeology

SCIENTIFIC AMERICAN

July • 1931

35c A Copy

RIDING WITH THE SIGNAL IN THE CAB



SCIENTIFIC AMERICAN, July 1931, Vol. 145, No. 1 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Subscription price $4.00 per year. Foreign $5.00.

SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Comp... ...Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, ...t 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · JULY · 1931

SCIENTIFIC AMERICAN DIGEST

THIS MONTH'S COVER

In the cover picture we find ourselves looking into that holy of holies beloved of all small boys—the cab of an engine. The engineer and the fireman wigwag to each other whenever a signal is sighted, so that the alertness of the enginemen is never a matter of guesswork. When snow, sleet, rain or fog obscures the vision, the train must run under diminished speed unless the engine is equipped with some form of cab signal which duplicates the wayside signal. The article on page 14 tells how the invisible signals are picked up electrically so that indications in the cab notify both enginemen as to the condition of the track ahead.

WHAT A WORLD OF TROUBLE IT SAVES YOU!

WE KNOW a seed house that proves each season's crop of seeds in their own trial gardens before they offer them to the public. Flowers and vegetables grown from these seeds must measure up to definite standards, or else the entire crops from which the samples were taken are burned.

We know a manufacturer of dry batteries who tested a new product two years before he sold a single battery.

We know a manufacturer of an anti-freeze solution for automobile radiators who spent two years testing his product under all conditions before he said a word in advertising about the merits of his goods.

We know a manufacturer of household pharmaceutical products whose self-imposed standard of purity and efficacy is even higher than that laid down by the United States Pharmacopoeia and the National Formulary.

If we mentioned their names you would recognize them immediately. You probably would say, "I plant those seeds," "I use that battery," "I use that anti-freeze."

The four instances cited are typical of every reliable manufacturer in America. Millions of dollars are spent annually to develop and improve merchandise. Other millions are spent in advertising to tell you about them.

All of which is to say that in putting your trust in advertised merchandise you save yourself the bother, the expense, the disappointment—yes, the danger—of experimenting for yourself.

The advertisements in this magazine keep you informed of the newest and most advantageous merchandise that America's most progressive makers are producing.

ACROSS THE EDITOR'S DESK

A RARE—a highly rare—honor has come to one of our contributing editors, Professor R. W. Wood of the Johns Hopkins University, whose researches in physical optics are world-famous. The University of Berlin has conferred on him the honorary degree of Doctor of Philosophy. Some institutions confer so many honorary degrees that these carry little weight, but an honorary degree from the University of Berlin really "means something." The recommendation was given unanimously by the Faculty of Philosophy—Einstein, Planck, von Laue, Schroedinger, Nernst, and others. It is believed that no other physicist has received this honor from Berlin and it once more singles out Professor Wood as one of the world's foremost physicists. Further details are cited in the Scientific American Digest in this issue.

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Our August issue will contain so many articles of general and special interest that it is difficult to decide where to start in presenting a taste of the high-lights. Our tentative schedule, in its present form, shows an article on railroad dispatching as the "lead" story. In this article, prepared at our request by a railroad man who is thoroughly familiar with the ins and outs of the work, is told the story of time and its relationship to good railroading. The railroad dispatcher works hand in hand with time—accurate time—and the work he does results in the safety in which you travel when you go by rail. A series of especially made photographs illustrates various phases of the work.

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Mathematical physics, an offspring of astronomy, teaches us that the average weight of the earth, volume for volume, is 5.6 times that of water. But geology informs us that the bulk of the surface rocks, volume for volume, weighs only half as much as the earth as a whole. What then may we expect to find below the surface, beyond the greatest depth to which man has as yet penetrated? How can we investigate "The Earth Beneath"? Earthquakes and earthquake records give us something on which to work, and man-made "earthquakes" have produced still more data. The connection between the earth's composition and earthquakes is clearly drawn by the author of an article scheduled for our August number. He says, "The present theory is the latest model. . . . It may be traded in as soon as suggested improvements have been found worthy of adoption. All may rest assured that when better theories of the internal structure of the earth are built, seismology will build them."

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From time immemorial one of man's major battles for existence has been with the insects. In fact, so serious is the situation that L. O. Howard, recently Chief of the United States Bureau of Entomology, asks, "Which shall inherit the earth—man or the insects?" and answers with an article to be published soon. He points out that the insects have a great advantage, in their bodily structure, over the mammals, especially man, and that it is only man's mind and his ability to use to his own advantage nearly all other forms of life that have so far kept the balance in our favor. But we must do more than has been done to date and, with this in mind, the author reviews past accomplishments and outlines what must be done if the future rulers of the earth are to be men and not insects.

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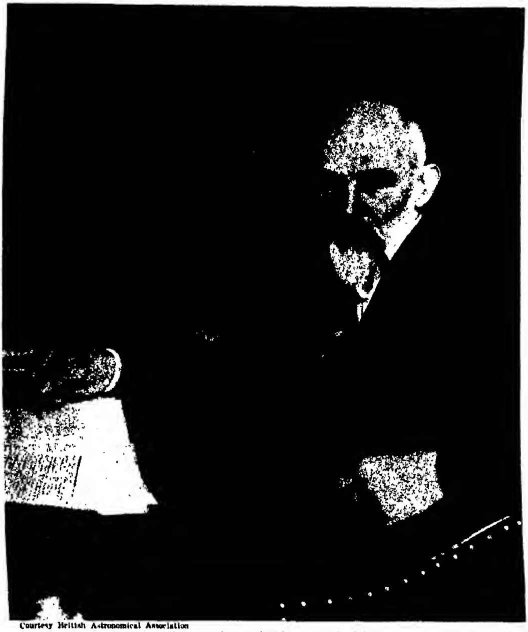
From your loudspeaker comes the roar of an approaching train, the rattle of a dilapidated motor car, the steady clop-clop of a horse-drawn buggy, the cacophony of a thunder-storm: you know that these sounds do not come from original sources, but you may wonder how they are produced so that they sound so natural. A short article soon to appear will tell how the production of such incidental noises is a specialized art in radio land; several photographs will illustrate the equipment employed for producing these sound illusions.

●

Over all the battlefield into which the world has been turned, with commerce and industry fighting for their lives against economic forces but little understood, there stands the spectacle of one mighty corporation that expanded tremendously during 1930 In point of gross income during that year, the American Telephone and Telegraph Company stands above all other corporations, private, state, or corporate, in all the world. One reason for this great income is that, in the United States, rapid communication in business and in the home has become almost as important as speech itself. Another reason is that the company spent 15,000,000 dollars for research -progress insurance -and nearly 600,000,000 dollars for maintenance, new equipment, and so on during the year. Other astonishing facts about this great company are coming in our August issue.

Orson D. Munn



Courtesy British Astronomical Association

WILLEM DE SITTER

THE world at large is not so familiar with the name of de Sitter, the Dutch astronomer-cosmologist, as that of Einstein, but within the realm of science his fame is comparable with that of the great relativist—his name generally being included in lists of the world's half dozen greatest living scientists. In the *Journal of the British Astronomical Association*, Mr. Frank Robbins characterizes de Sitter's career as "one of the most astonishingly fertile of the century," while the American astronomer Leuschner, speaking for the National Academy of Sciences, "doubts his ability to do justice to the greatness of the man."

Readers of science often encounter the term "the Einstein universe," "the de Sitter universe," and so on. Such expressions refer to these thinkers' concepts of the size, shape, and general nature, also the finiteness or infiniteness, of the totality of things. Of course, no existing telescope can penetrate the whole extent of the universe and therefore these concepts are based partly on inference. In de Sitter's universe, which is finite, space is curved or bent, not so much because of the presence of matter, as in Einstein's universe, but inherently. It is an unstable universe, expanding or contracting. Recent research by Hubble at Mount Wilson Observatory, actually indicating an expansion, favors de Sitter's concept and has caused Einstein to revise his own concept of the universe since he last came to America.

A MAJESTIC MOUNTAINSIDE MONUMENT TO FOUR PRESIDENTS

THE 60-foot head of George Washington nears completion—the nose tip must be rounded—in the gigantic group which is being cut into a 300-foot cliff on Mount Rushmore in the Black Hills of South Dakota by Gutzon Borglum. The heads of Jefferson, Lincoln, and Roosevelt, and a condensed history of the United States will complete the group. The surface is first cut back 40 or more feet to a seamless face. Measurements are then transferred from plaster models to the stone, and the figures are roughed out by careful blasting, often with blasting caps only. Finishing is done with pneumatic tools.

The new 73,000-ton Cunard liner as she will appear when completed in the fall of 1933. She will be launched in 1932. Great Britain pins her hopes of regaining the "blue ribbon" of the Atlantic on this ship, which will be 1018 feet long

CUNARD'S BID FOR OCEAN SUPREMACY

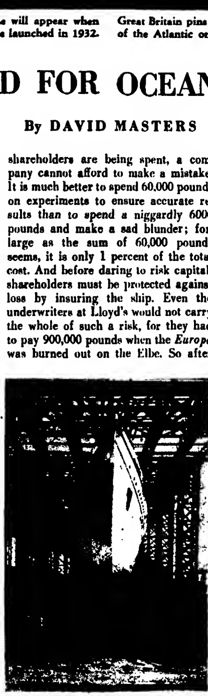
By DAVID MASTERS

WHEN the Cunard built that wonder ship of the seas, the *Mauretania*, the British Government provided a sum of 2,600,000 pounds at 2.75 percent interest and paid an annual subsidy of 150,000 pounds, in return for which the State was to acquire the services of the *Mauretania* and her sister ship in the event of war. That agreement, signed in 1903, concerned the building of two ships "capable of maintaining during a voyage across the Atlantic a minimum average speed of from 24 to 25 knots in moderate weather." For 20 years the *Mauretania* was queen of the Atlantic, faster than any other liner afloat, and then in her old age she beat all her own records and just failed by three hours to beat the record of the newly-built *Bremen* on the homeward trip.

FEW expected that Cunard would rest content with the record in German hands; and their decision to build a liner costing 6,000,000 pounds, with a length of at least 1000 feet, accommodation for 4000 passengers, a displacement of 73,000 tons, and a minimum speed of 30 knots is the best of all replies to the German challenge.

Behind the scenes, the world's greatest scientists in shipbuilding are now concentrating on their tasks. The fastest ship in the world springs into existence out of the combined work of many mathematicians and naval architects, and before the first girder of her keel was laid a fortune went into experiments and preparation.

When 6,000,000 pounds belonging to shareholders are being spent, a company cannot afford to make a mistake. It is much better to spend 60,000 pounds on experiments to ensure accurate results than to spend a niggardly 6000 pounds and make a sad blunder; for, large as the sum of 60,000 pounds seems, it is only 1 percent of the total cost. And before daring to risk capital, shareholders must be protected against loss by insuring the ship. Even the underwriters at Lloyd's would not carry the whole of such a risk, for they had to pay 900,000 pounds when the *Europa* was burned out on the Elbe. So after long negotiations the British Government has agreed to carry part of the risk on the new Cunarder—I should think about 4,000,000 pounds. Whether the Cunard company will pay its insurance premium to the State, or whether the premium will be reckoned as part of a new subsidy, in return for which the Government will have a call on the vessel, I do not know.



Before launching the *Mauretania*, fastest on the Atlantic for years

It is unlikely that the German ships will do very much better than they have already done, and whereas the *Mauretania* proved in practice to be 20 years ahead of her time, the German ships should not be more than three years ahead—if that much.

ALWAYS, of course, the Cunard company has its staff of marine architects working in its office at Liverpool. Then John Brown and Company, who are building the new liner on the Clyde, have their own staff of naval architects busily preparing plans. Moreover, the Admiralty architects will probably be consulted in the matter, if the procedure followed in the case of the *Mauretania* is carried out on this occasion.

Plans for the new ship have actually been under consideration by the Cunard company for a long time. For the *Mauretania*, the first plans were submitted by the builders, Swan, Hunter and Richardson, in 1901 and left until September 1902, while the liner herself did not start on her trials until October 1907. Vickers also submitted plans for her, as did John Brown. All these were duly considered before the Cunard architects drew up their specification

plans; so for the new ship there may be several sets of plans in which are embodied the finest ideas of the shipbuilding geniuses of Great Britain before the final specifications are decided on. And these final plans in their main particulars will have to be agreed upon by John Brown, Lloyd's, the Admiralty, and the Cunard company.

Building the biggest and fastest liner in the world may seem a simple task, once the money is provided, but there are so many interests involved that it is extremely complex. There is, for example, the vital question of docking her. She must go into dry dock now and again for repainting and cleaning. The mammoth floating dock of the Southern Railway (of England) is powerful enough to lift the *Mauretania*, the *Bremen* or any ship up to 60,000 tons, but it could not lift a 70,000 ton ship. So the Southern Railway has now decided to build the biggest dry dock in Great Britain to accommodate the new Cunarder.

It is equally necessary to ensure that there is a quay long enough to provide a berth for her, so while the ship is being built, the present landing stages of the Cunard company on both sides of the Atlantic will have to be lengthened several hundred feet. There was mention of some alteration in the Cunard landing stages in New York over a year ago, and it was rumored then that Cunard was preparing to build something big.

HAVING settled docking and berthing facilities, there is another important question—the depth of the channels which the ship will use in and out of her ports of call. The depth of water drawn by the ship must be less than the depth of the channels; otherwise this ship may sail the oceans and never make port. Therefore to build the world's biggest ship, long negotiations with harbor authorities in several countries may have to be conducted.

When the *Mauretania* was about to be built, the New York harbor authorities decided to go to the expense of increasing the depth of the New York channel, which enabled the Cunard company to increase the draught of the *Mauretania* from 32 feet 6 inches to 33 feet 6 inches— a most useful gain. The authorities on the Clyde also agreed to increase the depth of the river to allow John Brown to build a ship as big as or bigger than the *Mauretania*.

The Clyde authorities unluckily have in the bed of their river the famous Enderslie Rock, 900 feet long by 300 feet wide. As ships have grown, this has been blasted to increase the depth from 8 feet to 20 feet, at a cost in 10 years of 86,000 pounds. Further sums have since been spent, otherwise John Brown would not be able to build the new giant ocean liner for Cunard.

To enable the Swan, Hunter company to build the *Mauretania* on the Tyne, the river had to be dredged to a greater depth and the other bank had to be cut back a considerable distance to allow the ship to be safely launched. All these things, of which the average man never thinks, must be dealt with before a ship like the new Cunarder can be put in hand. It is not just a question of the Cunard company deciding to build; they have to arrange technical matters with many authorities so that the new mammoth can pass from the slipway down to the sea and use her ports freely and without danger. Think of what a pretty mess it would be if a firm built a ship with a draught of 40 feet and then found the extreme depth of the channel to the sea was no more than 38 feet! I need not add that such a thing could never happen, for our ship-builders know their jobs and take everything into calculation, even to the weight of the last rivet.

The *Mauretania* and, beside her,

THE sea acts as a cushion to a 73,000 ton ship afloat, but on the slipway there is no cushion, and if the greatest foresight and care were not exercised she might be wrecked before ever she took to water. While this enormous weight is being gradually piled up a few tons at a time upon the earth, it might cause a subsidence that would strain the ship beyond the point of safety. The preparation of the slipway is thus of supreme importance and it has to be so solidly constructed of steel and concrete that it will not sink a fraction of an inch anywhere. It must be so tied together with girders that it forms a solid raft of concrete resting on the underlying earth, and if it reacted to the pressure at all, it would react as a whole, exactly as though it were afloat on the sea, so that the giant resting on it would not be injured.

Everything down to the minutest thing is being worked out mathematically and experimentally: the depth and width of the main girder forming the keel, the depth of the double bottom, how many cells it will have, the thickness of the steel, the particular kind of steel that will stand up best to the strain, the size of the rivets and the distance apart, the thickness of the plating in various positions, and the strength of the frames forming the skeleton of the ship. The very rivet holes will be beveled so that the sharp edges cannot cut off the heads of the rivets! The amount of work done by the most brilliant men before anything is seen on the slipway is incredible.

The designers seek to allow for the worst possible conditions that the ship could meet with at sea, and then give her a good margin of safety. With a ship 1000 feet long, they estimate the stresses she will have to stand if she is caught in the hollow of a wave the same length as herself with crests towering upward for 50 feet. Then they will cal-

Methods of building giant liners have been refined since this old photograph of the *Mauretania* on its slip was taken, but have not been radically changed

experimental yacht *Turbinia*

culate the strain if she is caught on the crest of such a wave. In the hollow, she is being supported fore and aft, and the tendency of her big weight pressing downward is to make her sag in the middle; on the crest the tendency is for the unsupported bow and stern to press downward and break her back.

With the *Mauretania*, they found that the greatest stress worked out at 10.3 tons per square inch on the top part of the girder, but since the steel used possessed an elasticity of 20 tons to the square inch, and a breaking load of 36 tons, the designers made her three times as strong as was necessary. Then for the first time silicon steel, invented by Sir Robert Hadfield, was used for a large portion of the hull, thus adding strength and reducing weight.

Even the matter of dry docking the ship will be gone into most carefully so that she may not suffer the slightest injury or strain. For such a monster, cast steel blocks will not be used alone, as they do not give at all to the enormous pressure, so they will be surmounted by blocks of elm, which is very hard and yet elastic, and on top will be placed caps of a softer wood, of a carefully calculated thickness, that will yield more to the pressure and act as a cushion.

When the plans are in the last stage, an exact model will be made for research in an experimental tank—probably that of the Admiralty at Haslar. For the *Aquitania*, the model was first shaped in clay and then cast in wax. As it was pulled up and down the tank, the power needed to draw it through the water was carefully measured by scientific instruments. The disturbance of the water was observed, and the wax of the hull was pared away by a machine which ensured absolute accuracy on both sides, until the designers found the type of hull which passed through the water with the least possible resistance.

FOR the *Mauretania*, a launch was built—just over 49 feet long—to one sixteenth the size of the liner, and named the *Turbinia*. Electrical machinery was installed; the wooden hull was so constructed that its shape could be altered at will; and experiments were carried out for two years with it in the Northumberland Dock on the Tyne. There were 500 speed trials for testing 12 different types of propellers; the builders sought the best position for placing them; whether three or four would prove more efficient; whether they should turn inward or outward; the best shape of blades and the correct angle at which to set them to the shaft. They found out how to cut away the hull of the ship at the stern to enable her to turn in the smallest space, they tested methods of steering by propellers and with the rudder. They proved that if she faced a 25-knot wind she would want 12 percent more power than when she steamed in a calm, that traveling with a similar wind she would require 4 percent less power. The performance of this small craft led to the installation in the *Mauretania* of the steam turbines which enabled her to hold the record for 20 years.

Calculations showed how much she would be slowed down if some of her propellers went out of action, and proved that simply by altering the position of the propellers they could attain the same speed and save 5000 horsepower. The experimenters even dealt with the power that might be lost by encrustations on the ship's bottom. There were the questions of water-tight compartments to ensure safety, of the best type of propelling machinery, and many other problems; and before some were settled the hull was actually being built, allowances being made for any modifications in design.

They arrived at the length and depth of the bilge keels which have made the *Mauretania* one of the steadiest liners at sea; they found out how she would behave when fully loaded, when half loaded, and so on. They left nothing to chance; everything that human sagacity could foresee was worked out.

EXACTLY the same processes are being followed in building the new Cunarder. She, too, will have expansion joints which will enable the upper decks to contract and expand slightly to ease the strain on her skin, for a ship 1000 feet long, however rigid she seems to be, is bound to give a little in stormy weather. The joint is covered by a brass plate which is fixed on one side and free on the other to move on a bed of greased leather which enables it imperceptibly to adjust itself to the expansion and contraction brought about by the huge seas.

While the marine architects and mathematicians are carrying out their endless experiments, the steel works are busy making those thousands of tons of girders that will become a ship, artists are designing schemes of decoration to make her the most beautiful thing afloat, furnishers are submitting schemes that aim at the maximum of comfort—shops, cinemas, a daily paper: there will be no end to the wonders of the new Cunarder, and it will certainly tax other designers to the utmost to outvie her in luxury or in speed.

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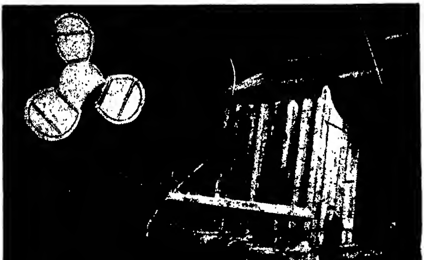
(Since the foregoing was written the keel of the new Cunarder, which will be 1018 feet long, has been laid down at ohn Brown and Company's shipyard n the Clyde, and the river authorities have decided to spend a sum of 80,000 pounds in deepening and improving the channel so that ships of this size may float safely down to the sea.—Author.)



Photographs courtesy Swan, Hunter and Wigham Richardson, Ltd.

The immense size of one of the *Mauretania's* propellers. Note how carefully the edges of the propeller blades are protected by guards during construction

OUR POINT OF VIEW

Albert A. Michelson

IF, as appears to be true, the only eternally permanent entity in the whole universe is light, then Michelson, who hitched his wagon to a beam of it and clocked it almost to the breadth of a hair, identifying himself so intimately with it that the one can scarcely be thought of without the other, has won immortality.

We may attempt to isolate Michelson's major achievements, summing them up broadly as the perfection of the Michelson interferometer for the measurement of the diameter of the stars, and the high refinement of the determination of the velocity of light—not to speak of the famous "Michelson-Morley" experiment whose unanticipated by-product was the Einstein theory of relativity. But when we have accomplished that much, Michelson's major contributions to science and to the world have little more than been touched. Everyone who has been in close touch with the inner world of physics and its personnel knows that Michelson's real contribution to science was simply in being Michelson, Michelson the leader, Michelson the teacher, Michelson the inspirer—especially the inspirer. To this a host of Millikans and Comptons who grew up under his tutelage will testify, as indeed they have on many occasions. He sensed which problems were big problems and not only directed the energies of his best workers toward them but knew how to keep them there. He made these men.

Here was a man who sought no limelight—though the limelight sought him. He cared not for riches—except those of an intangible sort. Fame never haunted him; in all his long career he wrote only two meager books and even these were largely pieced together, more or less as an afterthought, from short papers previously published. There is thus a kind of irony in the fact that Michelson's fame doubtless will live when the wealth of the richest has been wholly dispersed, when the world celebrity has been forgotten by a fickle public, and when most of the extant books long since have passed into the sad category of books of the hour. A man does not need these props to attain greatness—unless he does need them.

One wonders, too, just why it was that Michelson's chosen pieces of research seemed to lie so close to fundamentals. He tackled really basic problems—not that they were more difficult for that reason. Did he consciously choose to make sure that he touched only important things? Those who knew him doubt it. What dictated the man's choice of some of the more significant things in science as an outlet for his investigative urge doubtless was something wholly unconscious—we cannot define it, cannot describe it or isolate it, but all recognize it when they see it. It is simple greatness. Michelson was great.

Of personal reminiscence regarding Michelson we can relate but little. He was not very approachable because he knew we sought what he was not disposed to surrender—the time and energy required to write popular articles when he was aware that he had but little time left. He was old and had done enough hard work and now he intended to play. Taking time out to write articles would be like giving up little pieces of his life. He proposed to play, and play he did to the very last. Though described as "work," all his recent series of redeterminations of the velocity of light were play. When he worked hard on them he was playing hard. To him the problem was one not merely in physical optics but in esthetics. The refinement was not yet complete, the picture lacked necessary detail and precision, and his nature forced him to perfect it. This he finally did and in his 79th year he died. But Michelson the measurer lives on; it is the rest of us who die.

Above and Below the Arctic Sea

SHOULD nothing happen to interfere, the old submarine which was rented by Sir Hubert Wilkins from the United States Navy for one dollar a year, reconditioned and specially fitted, and renamed the *Nautilus*, will be on its way to the North Pole by the time this is in print. A prodigious amount of effort was expended to put this ship into first class sailing order and to render it as safe as human ingenuity and foresight could possibly make it. The *Nautilus*, nevertheless, will meet with obstacles to success such as no other submarine has ever encountered, for it must travel most of the way under the ice. The hardy souls who are risking their lives in this ship for the sake of science, will, therefore, be deserving of the laurels of pioneers should success attend their undertaking.

A recent press dispatch from Berlin says that Dr. Hugo Eckener plans a flight of the dirigible *Graf Zeppelin* to the arctic this summer for the purpose of contacting the *Nautilus*. Presumably the submarine and the dirigible would find each other by means of radio, and then the one would come down to the surface while the other bored its way up to the surface of the ice. The project is most ambitious but then both Dr. Eckener and Sir Hubert are the sort of men to carry it out if anyone can. Professor H. U. Sverdrup, famous Norwegian arctic explorer, doubts the possibility, however, for he says that July is a bad time of the year for an airship in polar regions, due to the fog and low clouds.

Whatever the result of the effort to make contact between the two ships, the world will watch with interest every mile of progress made by both. History of a kind unprecedented in the annals of science will be made by the *Nautilus* whether it attains its polar goal or not, and the *Graf Zeppelin's* flight will forge another link in the growing chain of conquests of the poles by air. Bon voyage and success!

Wages and Prosperity

AS business and industry begin gradually to adjust themselves to present conditions and to plan for the future, the controversy over the possibility of wage reductions is becoming more serious. President Hoover has consistently fought against such a step although many executives, bankers in particular, have as strenuously favored it. Mr. Mellon has said that recovery must come without it but the president of Europe's steel cartel recently declared that the theory that high wages are a guarantee of prosperity is a "mirage."

What is one to think? Statistics prove but little, if anything, in such a question and it is worse than useless to take the word of any man or group of men. There is much to be said on both sides, always considering, of course, the wage-earner himself. Those who are against wage cutting may be entirely correct in their theories as they affect the American working man, while Mr. Meyer, the European, may have precisely the solution for his side of the Atlantic.

There is no question but that the American working man is our biggest customer. He knows that his net income is very much higher under the high wage system than under the other; his percentage of "luxury" or "pleasure" cash is much greater under the former than under the latter. He has, accordingly, adjusted his standard of living

to a scale higher than Europeans know or have known. He has a car with all the necessary or foolish gadgets, a six- or eight- or ten-tube radio, good clothes, plenty of good food, and more comforts than a medieval king.

It is true that the cost of living in the United States has steadily declined during past months until it is now very near the pre-war, 1913 level. This being the case, some will say that it should be a simple matter to reduce wages in proportion. We think differently. Labor is against it. In fact labor has shown its determination to maintain, if possible, the basic rate of wages by co-operating in the reduction of weekly working hours, and by voluntarily adopting other compromises. Indirectly, such action means the low[illegible] of the weekly payment temporarily, but it helps to insure the retention of the basic rate until the return of prosperous times. Should wages be sliced horizontally, there is almost sure to be an impairment of efficiency; and furthermore, it might result in formidable strikes such as have characterized similar attempts in the past.

Labor is going to hold on as long as it can. It is going to be no easy matter to adjust wages to a lower level even if, in time, that is shown to be the only feasible thing to do. Nevertheless, others besides the working man have felt the depression, and on a stupendous scale. If, therefore, the restoration of economic balance can be effected in no other way, it may finally be necessary to reduce wages, in certain lines at least, and labor must be prepared to nake that sacrifice [illegible] [illegible]ake progre[illegible] toward a new era of high wages and prosperity.

Down With Crooks!

GANGDOM isn't having such a pleasant time of it at present. The federal government has recently jailed several "public enemies" in Chicago for failure to pay income taxes; and is now invoking the same weak process for eliminating a few New York criminals from the scene of action. In Chicago, Mayor Cermak promises a widespread cleanup of crooks, a[illegible] New York, Police Commissioner Mulrooney is doing exceptionally good work both in capturing criminals and in giving them a dose of their own hot lead medicine. Other cities are doing good work but not in so spectacular a way; and foreign-born outlaws from all over the country are being deported in large numbers.

In this fight against a menace to society, there is one bit of knowledge that is not used to advantage and that is that the criminal is, first of all, an egomaniac. He sees himself pictured in the newspapers as a "king of this or that racket," a "two-gun gangster," or a "dangerous desperado," and his ego is inflated to the dimensions of an over-size rubber balloon. He swaggers among his crowd and boasts of his cleverness. He even sneers at the police. "You ain't got nuthin' on me," he chants every time he is picked up—so often has he said this, in fact, that it has almost become a litany of crookdom.

To make our fight more effective, the balloon should first be pricked. This could be done to some extent by coining a word that will describe the crook for the leper, parasite, thief that he actually is. This word should have none of the glamor of the pirate or the western six-gun man of fiction but should, instead, be comparable in its implication to the crook himself with the word "stool-pigeon." Having coined such a word, opprobrious to the n-th degree, someone—a reporter perhaps or a popular writer comparable, we'll say, to Edgar Wallace—should give it wide currency. Perhaps it would not cause the crook to reform, but it would so tarnish the luster of his notoriety that youths would hesitate to follow in his footsteps. Newspapers could help much in thus debasing criminals.

[illegible] thing to take some of the bravado out of the physical coward that every crook is, would be to give him the lash. One state which we won't name does this and it is said to "degrade" the criminal so much in the eyes of his fellows that that state has very little crime. It would seem, therefore, that public spanking of habitu[illegible] [illegible]ed for other states. [illegible]e, there are many people who would like to see this method tried o[illegible] Thieves and murderers might thereby be shown that they are not the desperate he-men they think they are.

Human Engineering

STEVENS Institute of Technology [illegible] [illegible] with far-sighted plans for choosing a[illegible] training engineers. The late[illegible] [illegible] New Jersey where students from preparatory schools will [illegible] enter the engineering profession. Leaders in science, engineering, architecture, and education will constitute the faculty.

Science and engineering are exerting a stronger appeal [illegible] the youth of our land than ever before; and yet the simple desire to enter these two interwoven fields, no matter how strong it may be, is no criterion of fitness or promise of success. Very often, in fact, such desires, unanalyzed, lead to tragic failures. If, however, prospective engineering students can be given an actual taste of the work they think they desire—a bit of surveying, some miniature engineering problems, and lectures and movies on mining, building construction, machinery design and operation, and so forth—they will begin to get a clear-cut conception of engineering as a career. All this the Stevens summer camp this August proposes to do and more: it proposes to analyze these youthful would-be engineers, discover the brilliant ones, and weed out the misfits.

Stevens should have a large degree of success with this first camp. The plan seems to have great possibilities, and is worth, we believe, the careful consideration of other institutions of learning.

Television Makes Its Bow

WE were intensely interested in the recent television demonstration, described on page 33 of this issue, n[illegible] much for the sake of the apparatus involved, which was essentially old, but because it represented the first attempt to place television on a commercial scale at the command of the public. Whether this "sight broadcast" station will succeed or fail we do not know—certainly we wish them well, if for no other reason than as recompense for their resourcefulness.

Frankly, it is our opinion that television systems based on mechanically operated parts—scanning disks and the like—are not the ultimate solution to the problem of placing in every home a "talking motion picture." But they serve as a starting point, just as the crystal detector and head-phones of 1921 served to whet the public appetite for radio to such a degree that the way was opened for the multi-tube receiver and powerful loudspeaker.

Although none has as yet come to our attention, it is wholly probable that in the wake of public interest in this initial sight broadcasting service will come many other systems, among which there will be some that are proposed for no other reason than to take the public's money. Certainly, with the many experimenters that are working on television today, the art is going to suffer from a plethora of methods and from the growing pains of financing problems. But from the chaos there may emerge something new, something so startlingly simple that it will place television on the basis that it deserves. We hope that when this time comes, those who have so ably pioneered in the field will be in a position to reap the benefits that should accrue to pathfinders.

RIDING WITH THE SIGNAL IN THE CAB

RAILROADING is much safer today than it was even a decade ago. Some of the brightest minds have devoted their best efforts to this end. The automatic train stop was a great milestone on the road to railway safety and now we have a tested system which reproduces in the cab of the locomotive the indications of the wayside signal and also tells of track conditions ahead. One of the great handicaps with which the engine crews have always had to contend is an obscured view of the signals caused by fog, rain, or smoke from passing trains. All these factors play an important part in curtailing the enginemen's view of the signal which is fleeting at best, even in fair weather. However, the cab signal duplicates the signals themselves, according to the system in use—color signals, position signals, et cetera. These cab-duplicated signals, when unfavorable, or in other words indicating danger, if unheeded by the engineer, result in blowing a whistle in the cab which will cease only when the engineer turns the acknowledging switch, showing that he is alert and at the throttle.

These signals may be combined with automatic train control which lays a heavy hand on the air brake valve if signals are unheeded. In other words what happens in effect is that as an engineer sees a wayside signal, it is picked up and placed alongside his gages. The cab signal is weird in its operation, for the signal currents are picked up through space while traveling at high speed without physical contact of any kind. This system increases track capacity, warns of broken rails, and saves the coal pile. A poll of enginemen running between New York and Washington with both types (that is, the automatic stop and forestaller and the cab signal with whistle and acknowledger) showed that they voted 449 for the cab signal and eight for the automatic control. The saving in mental wear and tear on the crew is also very great.

The mechanism on the locomotive is controlled by energy from the track circuit in which a code transmitter is connected across the rails at the exit end of the block. The track current is interrupted hy means of the code transmitter situated at the signal, the number of times per minute depending upon the condition of the track in advance. The codes used are 180 per minute for "clear," 120 per minute for "approach restricting," 80 per minute for "approach" and a steady current or absence of current for "caution slow speed."

ON the engine are the receiver, the amplifier set, the acknowledging and decoding relay group, and the decoder (all contained in the equipment box), the cab signal, the warning whistle, the dynamotor or dual-voltage headlight generator, the acknowledging switch, and the main switch.

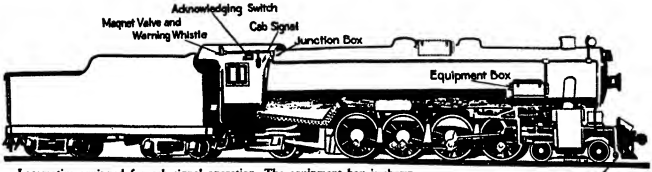
At "caution slow speed," the cab signal is supplemented by a warning whistle which the engineer acknowledges

The receiver is the means by which the control is transmitted from the rails to the apparatus on the engine. It is made up of a laminated iron bar on which are two coils connected so that the voltages induced in them by the normal 100-cycle track circuit currents are additive. It is mounted six inches above the rails, ahead of the front truck when the engine is equipped for forward running; when it is desired to equip an engine for reverse running, all that is required is another receiver back of the last pair of wheels on the rear of the tender, and a reversing switch, operated by the reverse lever on steam locomotives or by the plug switch on multiple unit electric cars.

The equipment box is usu-

Front and mounting of equipment box which contains the amplifier set, acknowledging relay, and decoder

The receiver, an iron bar and two coils, is mounted ahead of the forward wheels and picks up the control current



Locomotive equipped for cab signal operation. The equipment box is shown in other possible positions by dotted lines. There is no contact with the rails

ally mounted on the pilot deck of the locomotive, although it may be mounted elsewhere, if more convenient. It is equipped with shock-absorbing platforms to eliminate the effect of vibration on the apparatus. The various parts of the equipment contained in the box are so mounted that any part may be removed without handling the others. The external and local connections are made by means of plugs and cables, the male and female connections of which are arranged in such a manner that the proper connections are guaranteed.

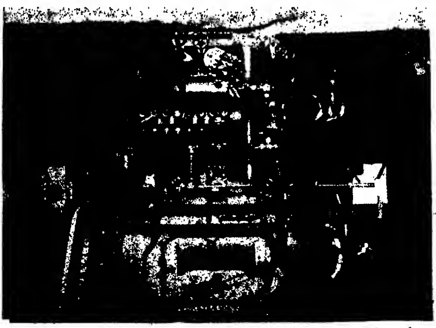
THE voltage induced in the receiver coils is delivered to the amplifier which in turn delivers to the electrical apparatus on the engine a greatly increased amount of electrical power for its reliable and safe operation. The amplifier is provided with two vacuum tubes similar to those used in radio, but sturdier and adapted to higher current values. The master relay and the master relay transformer are built into the amplifier unit. The master relay transformer transmits power at the proper code frequencies to the master relay. The master relay, which changes at code frequency the polarity of the 32-volt direct current that is supplied to the primary winding of the decoding transformer, is operated by the master relay transformer. In order to provide protection against arcing at the master relay contacts, a condenser is placed across them to act as a spark arrester.

The decoder comprises a decoding transformer with the reactors and condensers necessary to tune the decoding relay circuits to their proper code frequencies. The cab signals, controlled by the decoding relays, indicate the track conditions ahead. These signals may be provided for both engineman and fireman. The cab signal is placed in such a position in the cab that it is in line with the engineman's vision as he watches the track ahead. If the signal indication is ignored a warning whistle sounds. An acknowledging switch is located within convenient reach of the engineman. Reversing it causes the warning whistle to cease sounding and shows that the engineer is alert, but it sounds again on any subsequent change to a more restrictive indication and must again be acknowledged.

The Union Switch and Signal Company of Swissvale, Pennsylvania, have spent years of experimenting and immense sums in perfecting cab signaling. Over 18 roads have adopted cab signaling in one form or another and as time goes on vast installations will probably be added to those already in being. The track milage equipped for continuous cab signal operation, if connected, would provide for a three track road from New York to Omaha and for a double track road from Omaha to San Francisco. The locomotive milage protected by continuous cab signals exceeds 5,000,000 per month. Over 6700 miles of track and 4243 locomotives and multiple unit electric cars are equipped with these systems.

It is interesting to note that inventors here and abroad have been attempting to solve the problem of the cab signal since 1850 and some of the devices have considerable merit, but they practically all depended on some form of contact while the successful system we have described depends on a receiver mounted above and out of contact with the rail or any other object. Therein lies its great merit.

A four indication position signal in the engineer's line of vision



Four indication position light cab signals are duplicated so that both the engineer and fireman are continuously informed of the condition of the track ahead

QUICK-FREEZING SOLVES FOOD PROBLEMS

By D. H. KILLEFFER

A FRESH peach in New York's midwinter stood in one of O. Henry's short stories as the sign and symbol of high adventure and attainment. A bare 20 years ago that was, yet today the finest of peaches are ceasing to be more than a table delight and the seasonal adventure has been taken out of them forever by the modern processes of "quick-freezing." Were it not now mid-winter in New York and were the writer of this piece not an incurable admirer of the Caliph of Bagdad-on-the-Subway, peaches would not be so prominently mentioned here. The story properly begins with a fish instead of a peach, but where (if ever) it will end, no one in this year of unemployment and investigations can tell.

A DEAD fish that swam about in flat denial of its demise is credited with having set in motion the whole train of things which has resulted in a method of food preservation so far superior to anything we have ever known that it threatens to upset the whole human dietary. Whether the fish really was the cause of it, need not concern us now. At least it is an interesting story and may very well be perfectly true. The scene of the story is the northern ice in winter and it relates how a fish caught through a hole in the ice froze very suddenly when he was drawn from the water into the below-zero atmosphere. Stiff and hard with all the customary evidences of death, the fish was taken to the camp and thawed as a preparation for the frying pan by being put into more or less warm water. Many hours had elapsed since the wintry wind had frozen it to death, but in spite of that it swam contentedly about the tub of water just as if nothing had happened!

No one knows how often a similar resurrection has been witnessed by fishermen. At least we may assume that it was a commonplace since no one had taken pains to write of it in a book. It is told that this wonder so struck a scientist one day, that he fell seriously to thinking about it. From it he evolved a theory and from the theory has come an industry which today promises marvels in allowing all of us to enjoy all of the kindly fruits of the earth whenever and wherever we choose. The result is already a living, growing reality. Many have contributed to materializing this dream and barely enough has so far been accomplished to whet one's curiosity and to stir one's imagination about what it may do to our future.

Now it is perfectly plain that any treatment which allows the fish to recover all of its functions later does not in any way impair its value for food purposes. After such a sudden freezing, the fish is without question quite as good to eat as if it had just come out of the water. And that is just what is accomplished by the modern processes of so-called "quick-freezing."

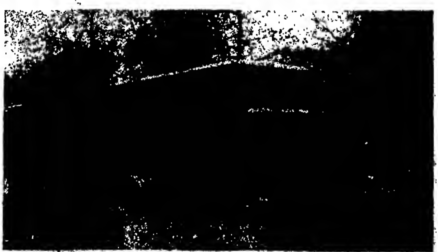
Courtesy Dry-Ice Corporation

Fish, maintained at a low temperature, is delivered just as fresh as when caught

Peaches and fish have been mentioned as subjects of the new art, but these merely suggest its possibilities. All manner of fruit, flesh, vegetable, animal and fish food-stuffs lend themselves readily to this method of preservation. Even the family quart of milk which everyone knows is injured by the cold of a winter's morning retains every characteristic of fresh milk after it has been "quick-frozen" and thawed again!

THE first serious effect of this process on the business of feeding the world has been an investigation of our facilities for the production and maintenance of the comparatively very low temperatures required to keep such frozen foods in proper condition on their way to the ultimate dinner table. The second, no less important in its effect, has been an extension of the modern idea of branded individual packaging to perishable foodstuffs in a way otherwise impracticable. So fundamentally important are both of these that one cannot overlook them when considering the major economic forces today at work in our civilization.

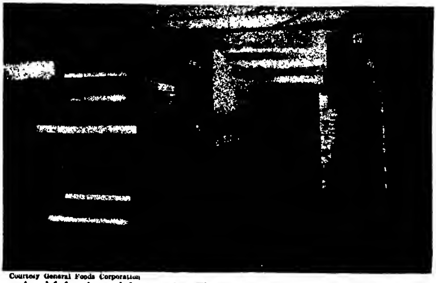
An eminent authority has recently stated that 16 cents of every dollar of value in perishable foods, consumed in New York City, is lost between the time these are landed at the piers and the



This truck and trailer highway transportation unit has a total capacity of 20 tons. Six hundred pounds of Dry-Ice maintain a constant temperature. If a similar unit were designed for ice, about 6000 pounds of ice would be required

time they are utilized by the ultimate consumer. Obviously here is an opportunity for tremendous saving by the "quick-freezing" method of distribution.

Although the art of cold production has been developed rapidly in the last decades, the present impetus given its development is likely to push it still faster ahead in the coming few years. The reason for this lies in the important difference between ordinary refrigerator or even cold storage temperatures and those now imperatively necessary to meet the needs of "quick-freezing." It is essential that the freezing process itself be accomplished with the utmost speed and this can only be done if the freezing medium is at a very low temperature. (For further details see page 250, March 1929 SCIENTIFIC AMERICAN. *Ed.*) As cold as 35 or 40 degrees below zero is considered by many to yield the best results although others perform the operation at as high as ten degrees below zero. At any rate the temperature is far below any required for other refrigeration purposes and hence has necessitated serious revisions in the machinery used.



Courtesy General Foods Corporation

A quick-freezing unit in operation. The pans of material to be frozen are placed on the endless belts and passed through a low-temperature refrigerating system

AFTER the freezing operation the product must be kept cold, much colder than ordinary refrigerators, until it is ready to be consumed. Any slightest thawing or even approach to it is fatal to the quality of the food and hence cannot be tolerated. This means that from the instant of freezing it must be maintained somewhere near zero for complete safety and this is thirty to fifty degrees colder than customary refrigerators. The problem thus presented is really different only in degree from ordinary refrigeration but this difference is actually great enough to suggest a total difference in kind. Whereas one may ordinarily utilize any temperature near but not below freezing for preserving perishables, "quick-frozen" foods must be continuously kept far below that point not only in storage but in transit as well, for the reason that if the temperature rises considerably the conditions of the tissues of the frozen food, which are inherent in "quick-freezing" as already described, become those of slow-freezing and all advantage of the former method is thereby lost.

An experimental quick-freezing cabinet in which Dry-Ice is used. With this unit, fish can be frozen solid in 20 minutes

To meet this situation every effort is being made to develop and perfect means for solving the new problems faced in the growth of this lusty infant industry. The ice cream industry has met and solved a host of similar problems but on a less grand scale, and from its practices in the use of solid carbon dioxide (well known by the trademark "Dry-Ice") and mechanical refrigeration much is adaptable to the new needs. However, ice cream has always been drawn out of hidden storage and food purchasers have always insisted on seeing what they were soon to eat. This has complicated the refrigeration problem seriously, for it is one thing to produce cold in a tightly insulated box and quite another to accomplish the same result in a glass show case.

Undoubtedly the final outcome will be something resembling an ice cream cabinet much more closely than it does a present day display case but that will take time. At present the big problem is to provide retailers everywhere with sufficient refrigeration safely to keep "quick-frozen" foods. The effect of this on the business of building refrigerators may very well be the leading factor in bringing the world from its present slough of economic despondency for literally billions of dollars must be spent in equipping hundreds of thousands of retailers with an amount and a quality of refrigerated equipment never before dreamed of to complete the development already under way. This process of revising retail food store equipment will require years for its completion and in the meantime drug and confectionery stores will probably be the first in the field with the new products because inadequate though it is their present equipment will better handle them than that of any present food store.

IN this process of re-equipping retailers many mistakes will naturally be made in adapting conflicting ideas of what people want to the essential requirements of "quick-freezing." However, the possibility of branding a beefsteak, a mess of fresh peas, or a portion of spinach, so that the responsibility for its excellence is definitely fixed, points directly to a public confidence already built up around advertised brands. It is quite unnecessary for a housewife to see the actual contents of a tin can bearing a familiar label, and the same will hold true of the products of the new process after it has gained public confidence.

Incidental to the matter of individual packaging, but fundamental to the economics of the new era in foods, is the fact that preparing food for "quick-freezing" definitely prepares it for the cook. This allows all the offal, bones, fat, skins, seeds to be removed mechanically at a central point where sufficient quantities of wastes are collected to allow their profitable utilization for purposes other than food. Not only do these wastes have value when thus collected in quantity, but the reduced weight and bulk of the prepared food effects a considerable saving in handling costs. These combined savings are enough to offset nearly, if not completely, the additional costs of the processing so that

A package of ice cream, kept cold with Dry-Ice, needs no bulky packing of ice and salt

the ultimate result of the new procedure will be to provide the housekeeper with higher quality food at no increase in the customary stretching of the kitchen budget.

WHILE we have used the term "preserve" to designate the result of the process, we must carefully point out that its product is kept over an indefinite period in *exactly* its original state without change of any sort. It requires no imagination for the eater to believe that "quick-frozen" Georgia peaches in January were picked the day they were eaten and brought by some strange magic from a far-off origin to one's own dinner table in the twinkling of an eye. Nor need a Kansan or a resident of the desert country have any strain put upon his credulity to believe the fish on his plate to have been whisked by some fairy charm from the depths of the sea within the hour. It is scarcely thinkable that one who has tasted the delicacy of "quick-frozen" foods will be guilty of comparing them with "canned" stuffs, but rather he will realize that this method of food preparation yields a product directly comparable with a garden, a fishing bank, an orchard, or an abattoir directly at hand. Like our cave-dwelling ancestors, we of the modern world are limited in what we eat by what we can get, but unlike them our reach has been enormously extended beyond the length of a skilfully wielded club or an accurately aimed arrow. And now our dinner table reach can go around the world.

Great improvements in the methods of cold production, and particularly the general application of solid carbon dioxide (it is more familiar under the trademark of the pioneer in the field) to transit refrigeration, are rapidly minimizing the effect of distance as a limiting factor in perishable food distribution. The adoption of "quick-freezing" methods is similarly operating to nullify the effect of time. It is quite unnecessary, to return to our original statement, that a Georgia peach be plucked before it is completely, lusciously ripe in order that proper refrigeration can get it to market within a few days, when by "quick-freezing" at its delightful best it can be transported safely unchanged to the ends of the earth and eaten months, if not years, later by a Hindu or an Eskimo in his own house.

In other words, this newest development in food handling makes all of the most perishable foods and fruits of every land and clime possibly available to anyone anywhere at any time. That statement is almost too startling to be believed, but it has been proved unquestionably true. Its ultimate meaning cannot be realized today, but even a scant glimpse of its potentialities staggers one. To consider only one phase of it, recall that practically a third of the orange crop in the United States is wasted because it becomes too ripe for shipment and that in this state it is at its prime best. By "quick-freezing" the juice of this ripe fruit, it can be marketed anywhere at any time in exactly its original condition. This will relieve the grower as well as the consumer of an expensive waste and probably will do more to make that kind of farming, and others like it, profitable than reams of legislative enactment could possibly accomplish. All kinds of perishables now available in limited territories or for short seasons can be similarly saved.

For the consumer this places at his beck and call anything, however rare and perishable it may be, which can be grown anywhere; and what may be quite as important, it promises a decrease rather than an increase in the cost of delicacies now beyond the reach of the average purse. Indeed, with that other modern wonder, home-made sunshine, it promises to do away in a great measure with the necessity for travel into far lands to cures of one sort or another. After all, the advantage of a winter in the South for the relief of rheumatism, for instance, is compounded almost equally of energizing sunbeams and a healthful diet. If these can be had at home, the urge to changes of climate for health vanishes.

THERE is another broad outlook into the future which it is permissible to deduce from past history. Every business depression has had some particular advance in industry upon which to build and hasten prosperity. In one case it was the automobile, in another the war, and for the last depression it was the airplane. With all the additional machinery necessary to maintain the lower temperatures—where, in an established refrigeration system, it will require a machine of practically three times the old capacity—the special display fixtures, and the entire change in the aspect and furnishings of the places of distribution, is it beyond acceptance to prophesy that "quick-freezing" will be the stepping stone to new prosperity?

●

One of the many feature articles scheduled for our August issue deals with railroad dispatching; it brings out many facts hitherto unknown to the general public.—The Editor.

A specially designed shipping carton for, in this case, packages of sausages, wherein the central compartment is designed to hold the Dry-Ice refrigerant

KEEPING THE STOCK EXCHANGE FIT

THE New York Stock Exchange seems to be a queer place to be taken sick. Still when a member is taken sick he should be treated so that he may be returned to the trading floor without loss of time, for a broker is a pretty valuable piece of human machinery, if the cost of a member's seat is considered. Realizing that the great organization has an obligation to its employees, the Stock Exchange gave up a valuable floor in one of its buildings for a Medical Department which is designed not only to deal with emergencies but to oversee the health of the

Tickers in member's room

Admission room

employees, of which there are 2444 of the Stock Exchange and affiliated companies, and 2250 telephone operators. This department also gives service to the employees of member firms and to brokers if they desire. In the case of member firm employees, an annual fee under a group plan is provided and the service is offered to smaller concerns on a fee basis. In either case the fees are designed to cover only the cost of operation. The equipment of the Medical Department cost 125,000 dollars and was installed under the able direction of Francis H. Glazebrook, M. D., F. A. C. S., as Medical Director.

All photographs copyright New York Stock Exchange

A doctor's office

Physio-therapy department

All employees are examined when they enter the service of the Stock Exchange, with annual examinations thereafter. The same advantages are offered the member firms. The plant includes a chemical laboratory, X-ray laboratory, electro-cardiograph, physiotherapy, and dental departments. Dr. Glazebrook has six associate physicians, including an eye and ear, nose and throat specialist, pathologist, and dentist, also nurses and technicians—23 in all besides 11 consulting physicians and surgeons.

AIRPLANES LAND BLIND—GUIDED BY RADIO*

By H. DIAMOND and F. W. DUNMORE

WHILE scheduled air transportation has been immeasurably aided by the provision of radio direction facilities on the fixed airways, interruption of scheduled flying is still the rule whenever the landing field lies in an area that is blanketed by fog. The results secured by the development of instrument flying and of radio navigational aids to point-to-point flying are then nullified through the lack of means for safe landing under adverse conditions of visibility. The rigorous maintenance of scheduled flying by day or night requires the removal of this last great hazard to the reliability of air travel and transportation.

A radio system of blind landing aids, developed in the aeronautics research division of the Department of Commerce at the National Bureau of Standards, gives good promise for the solution of this difficult problem. The results already obtained with this system indicate that it will soon be ready for use under the severe conditions encountered in commercial air transportation. The system has been developed to be adaptable for use in conjunction with the radio navigational aids already being provided for point-to-point flying on the civil airways of the United States.

This system includes three elements in order to indicate the position of the landing airplane in three dimensions as it approaches and reaches the point of landing. Lateral position, given for the purpose of keeping the airplane directed to and over the desired landing-field runway, is secured through the use of a small directive beacon, of the same type as the visual radio range-beacon provided for point-to-point flying on United States airways but lower in power and using small loop antennas. Longitudinal position, to inform the pilot that he has arrived within the boundaries of the landing field, is given by a boundary-marker beacon operating on the same radio frequency as the runway localizing beacon. Vertical guidance is given by an inclined ultra-high-frequency radio beam. This landing beam operates on a frequency of the order of 100,000 kilocycles (three meters), and is directed at a small angle above the horizontal. It is used in such a way as to provide a very convenient gliding path for the landing airplane.

A general idea of the use of the complete system may be had by reference to Figures 1 and 2. Figure 1 is a plan view showing the location of the ground transmitting equipment for orienting a pilot along the desired landing runway, while Figure 2 illustrates the function of the landing beam when used in conjunction with the other elements of the system.

REFERRING to Figure 1, the two-kilowatt directive radio beacon with large loop antennas, shown at A, is the main radio range-beacon provided for point-to-point flying on the fixed airways. This beacon is normally located just off the airport (so that the large loop antennas may not constitute an obstruction to flying), and serves to direct an ing airplane to the vicinity of the airport. A medium-frequency receiving set is used on board the airplane for receiving the course indications from this beacon. Utilizing a sudden cessation of received signal which occurs directly over the beacon tower, it is possible to locate this beacon to within 100 to 1000 feet, depending upon the altitude of the airplane.

Before reaching the beacon tower, the pilot has learned the wind direction at the landing field either through the Government weather broadcast or by two-way radio communication with the ground. Upon receiving the zero-signal indication, directly over the tower of the main beacon, the pilot retunes his medium-frequency receiving set to the frequency of the low-power (200-watt)

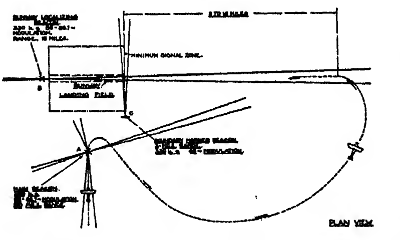


Figure 1: Layout of ground radio equipment for system of field localization

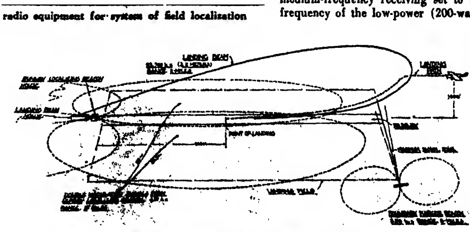


Figure 2: A three-dimensional view of the system of blind-flying aids

runway locali...
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so that it may ...
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the main beacon relative to the desired runway, the pilot then uses his navigational instrument (such as the magnetic compass) for orienting himself along that runw... ceived fr... greatly f... crossing the boundary of ... field, a signal from the marker ... operating on the same radio-frequency as the localizing beacon B, is obtained.

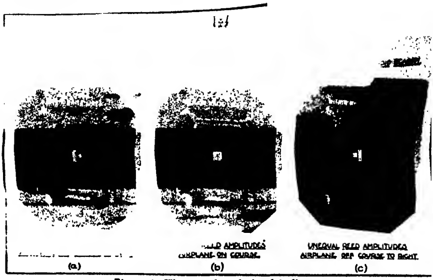


Figure 3: **The tuned-reed visual indicator**

REFERENCE to the three-dimensional illustration in Figure 2 will show how suitable indication of absolute height above ground is secured. The vertical space pattern of the inclined ultra high-frequency landing beam is clearly indicated. The polar pattern in the horizontal plane is about the same as that shown in the vertical plane. The airplane is readily directed approximately along the horizontal axis of the beam by means of the course indications from the runway localizing beacon. It does not, however, fly along the inclined axis of the beam but on a curved path, the curvature of which diminishes as the ground is approached. This path is the line of equal intensity of received signal below the vertical axis of the beam. The diminution of intensity as the airplane drops below the inclined axis is compensated for by the increase of intensity due to approaching the beam transmitter. Thus, by flying the airplane along such a path as to keep constant the received signal intensity, as observed on a meter on the instrument board, the pilot comes down to ground on a curved line suitable for landing. If the airplane rises above this line of equal intensity of received signal, the meter deflection increases, while if it drops below this line the meter deflection decreases.

Several important advantages result from this method of furnishing altitude indication. The pilot following the landing path is automatically kept above obstructions and no longer needs a thorough knowledge of the terrain in order to effect a safe landing. Secondly, the landing path may be of different shape to suit different landing fields. This is of particular importance in getting into a small field. A third advantage lies in the fact that in the act of following the landing path, the pilot automatically "levels off," thereby facilitating a normal landing, albeit somewhat fast.

In following the landing path prior to entering the marker beacon zero-signal zone, the pilot maintains an air speed somewhat above the landing speed of the airplane, insuring complete controllability with some margin to spare. Upon receiving the marker indication that he is passing over the boundary of the field, the margin over the landing speed may be reduced. The landing is therefore made at a speed more nearly approaching the normal landing speed of the airplane. A fourth advantage is that the landing glide may be begun at any desired altitude, within a rather wide range (within 500 to 5000 feet). Thus, referring to Figures 1 and 2, once the pilot has oriented himself in a direction along the runway, at any distance from the landing field, he flies at a convenient altitude, say, 1500 feet, until the landing beam indicator shows a predetermined deflection, at which point he begins the landing glide.

As has already been pointed out, the medium-frequency receiving set normally employed for the reception of the weather broadcast and radio-beacon services is also used for receiving the signals from the runway localizing and marker beacons. The localizing beacon is of the visual type, permitting the use of automatic volume control in its reception. This is quite essential, since the pilot, in making a landing, is con-

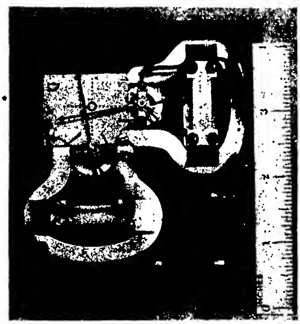


Figure 4: **Combined landing-beam and runway-course indicator; note crossed pointers and lines**

†At a landing field having two runways, perpendicular to each other, two localizing beacons are necessary so that the pilot may always land into the wind. Only one runway beacon will, however, be operated at a given time.

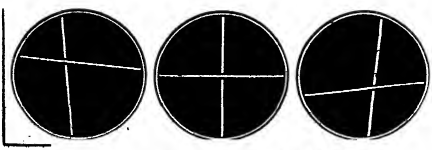


Figure 5: **Diagram of three indications given by the combination instrument shown in Figure 4 above. These show three different positions of plane. See text**

Figure 6 Complete receiving apparatus for blind landing of airplanes. *A* Medium frequency receiving set for voice and beacon signals. *B* Six foot vertical pole antenna *C* Filter unit for separating voice and beacon signals. *D* Tuned reed visual course indicator *E* Automatic volume control for beacon signals. *F*: Rough distance indicator *G* Landing beam receiving set detector unit. *H* Horizontal doublet antenna for landing beam receiving set. *I* Landing beam receiving set amplifier unit. *J* Landing indicator meter *K* Pilot's control unit for medium frequency receiving set *L* Pilot's control and test unit for landing beam receiving set. *M* A B and C batteries for operating the vacuum tubes

cerned with so many things that the burden of close manual adjustment of receiving set sensitivity must be eliminated

Automatic volume control also permits the use of a distance indicator This instrument consists of a milliammeter in the plate circuit of the radio frequency tubes of the receiving set and corresponds to the conventional tuning meter in broadcast receiving sets employing automatic volume control As the intensity of the received signal increases the plate current decreases This instrument may therefore be calibrated approximately in miles from the runway localizing beacon station Its operation is of considerable assistance to the pilot when circling the localizing beacon (during the process of finding the desired runway) and also in giving the pilot a sense of approach to the landing field once he has oriented himself along the runway

AN electrical filter circuit is connected in the receiving set output to direct the 1000-cycle aural signal received from the boundary marker beacon to the pilot's head telephones and the double modulation signal received from the runway localizing beacon to the visual-course indicator The course indicator may be either the reed indicator type, as shown in Figure 3, or the zero-center pointer type operated by a reed converter in which the deflections of the zero-center instrument are in the direction of deviation of the airplane from the course

A special ultra high-frequency receiving set is required for the reception of the landing beam signals No manipulation of this set on the part of the pilot is required the tuning is fixed Since a line of constant intensity of received signal is followed no control of volume is necessary The rectified output current from this set is fed to the meter constituting the landing beam indicator To facilitate its use this instrument is mounted on its side so that the pointer moves vertically instead of horizontally The deflection to be kept constant (corresponding to the desired glide path) is chosen at half scale reading the instrument pointer being then in horizontal position A rise of the pointer above this position indicates that the airplane is above the proper landing path while the reverse is true if the pointer falls below its horizontal position

Assume now that the zero center pointer type instrument is employed for securing runway course indications This instrument may be combined with the landing beam indicator into a single instrument (see Figure 4) which is much simpler to use than the two separate instruments. Two reference lines are provided on the face of the combined instrument, the vertical reference line corresponding to the position of the runway and the horizontal reference line to the proper landing path The pointers of the runway-course indicator and the landing path indicator are arranged so that they cross each other the former moving to the right or left of the vertical reference line and the latter above or below the horizontal reference line The position of the point of intersection of the two pointers thus gives through a single reading the position of the airplane with respect to the runway and proper landing path

The instrument indications for several arbitrary positions of the airplane are given in Figure 5 At (1) the airplane is to the left of the runway course and too high at (2) the airplane is on the runway course and on the proper landing path at (3) the airplane is to the right of the runway course and too low

THE runway localizing beacon is essentially a 200-watt double modulation beacon The two loop antennas crossed at 90 degrees carry currents of the same carrier frequency but modulated at different low frequencies—65 and 86.7 cycles These antennas are so oriented that the vertical plane containing the axis of the landing field runway bisects the angle between the two antennas An airplane flying in this plane therefore receives equal signals from the antennas On either side of this plane the signal received from one antenna is greater than from the other On the airplane a visual indicating instrument is employed which indicates to the pilot the relative magnitudes of the signals received from the two antennas and consequently the relative position of the airplane with respect to the runway

The boundary marker beacon operates on the same carrier frequency as the runway localizing beacon and employs a transmitting loop antenna

The receiving system on the airplane is as shown in Figure 6 The filter

Figure 7: Landing-beam directive antennas

unit serves to direct the reed frequencies to the reed indicator or reed converter, and the 1000-cycle marker-beacon signals to the head telephones. The automatic volume control is connected across the course-indicator terminals and, consequently, is actuated only by the localizing-beacon signals.

The landing beam consists essentially of a horizontal polarized beam directed at a small angle above the horizontal, this angle and the degree of directivity being so adjusted that a predetermined line of constant field intensity will mark out just the proper gliding path, clearing all obstructions and convenient for landing. In the set-up at College Park, Maryland, the beam is transmitted on a frequency of 93,700 kilocycles (3.2 meters) and is oriented in the same horizontal direction as the course of the runway localizing beacon.

AN ultra high-frequency was chosen for the landing-beam transmitting system in order to secure the attendant reduction in size and simplicity of equipment. A photograph of the directive antenna array, as set up at College Park, is shown in Figure 7. This is housed in a shed for protection against weather. The ultra high-frequency source (93,700 kilocycles) is coupled to the horizontal doublet, A, (made ⅛-inch copper tubing), which serves the radiating antenna and is accurat tuned to the frequency of the sour About 0.8 of a meter behind the radi ing antenna is placed a reflecti antenna, B, also a horizontal doubl tuned to a frequency somewhat lowe than the frequency of the sour approximately every meter in f the radiating antenna, horizontal-doublet directing antennas, C, are placed. These are tuned to a frequency somewhat higher than that of the source. This array of antennas is supported on

Figure 8: **The electron tube oscillator and doublet sending antenna for 93,700 kilocycle landing beam**

a horizontal wooden structure, D, approximately 2.75 meters above the ground, and pivoted on the vertical support E. To obtain the proper vertical directive characteristic, the wooden structure, D, is tilted approximately eight degrees above the horizontal.

The necessary power output on the high frequency used is secured through the use of a 500-watt three-element electron tube. Figure 8 shows the 500-watt tube and associated apparatus, including the horizontal doublet radiating antenna.

The receiving circuit arrangement (see Figure 9) uses only two tubes without regeneration. This receiving circuit requires no adjustments on the part of the pilot. Even the volume control is dispensed with, since the path followed during the use of the receiving set constitutes a line of constant field-intensity of the directed beam. A 224 heater-type screen-grid tube is employed for the detector, to afford the necessary high amplification without undue microphonic noises. To obtain good efficiency it is necessary to connect the detector tube directly in the center of the horizontal doublet antenna. The radio-frequency detecting portion of the circuit is confined to the section above the four radio-frequency chokes. (See Figure 9.) The four leads running from the lower side of these chokes carry either direct current or the received audio modulation.

The detecting portion of the receiving circuit (within the dotted lines) is

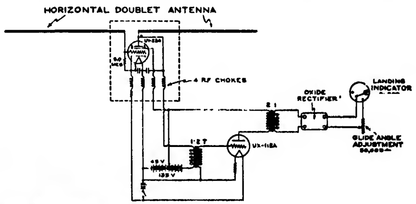


Figure 9, upper: **Landing-beam receiving circuit.** *Figure 10, lower, A:* **Streamlined detector box.** *B:* **Amplifier-rectifier.** *C:* **Doublet antenna. See Figure 6**

external to the airplane, being mounted in a streamline weatherproof box about 14 inches above the top wing. (See Figure 6.) The doublet antenna is in the form of two copper rods housed in wooden streamlined supports projecting from the streamlined detector box. The rest of the apparatus, which includes the audio amplifying tube and transformer, oxide rectifier, A and B batteries, and indicating instrument, are located within the airplane.

Figure 10 shows an inside view of the streamlined detector box. The amplifier-rectifier unit is also shown. The oxide rectifier eliminates one tube, and has been found perfectly stable in its operation at the low frequency employed. The streamlined detector box and antenna system is arranged to plug in electrically to the supporting upright on the wing, a five-terminal plug making the necessary connections.

A SPLINTERED PLANET?

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

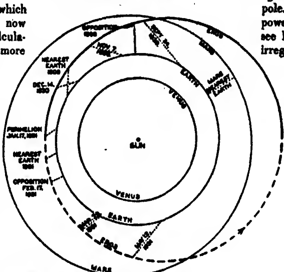
OUR nearest neighbor among the planets, the little asteroid Eros, has come and gone. Last January it was hardly more than 16,000,000 miles from the earth—nearer than any other body which has ever been observed, except the moon and two or three stray comets. By this time it is more than three times as far off and receding rapidly, and it will not come as near us again for more than half a century.

The hundreds of photographs which were taken at many observatories now await the measurements and calculations from which should result a more accurate determination of the planet's distance, and hence of the sun's, than has ever been made before. But this is a huge labor which will occupy years to come. Meanwhile, astronomy has been enriched by direct observations of a simpler but no less interesting sort.

THIRTY years ago, in February 1901, when Eros was also near the earth though not so near as this time, the German astronomer von Oppolzer noticed that its brightness appeared to change from night to night, and even from hour to hour. His discovery set many observers to work and it was quickly found that the variations were large and rapid. In an hour and a quarter the asteroid dropped from full brightness to less than 20 percent, to recover in about the same interval. Further study showed that alternate minima were not equally spaced nor equally deep and that the full cycle was $5^h\ 16^m$, during which the brightness rose and fell twice over, to repeat its changes accurately. Within a few weeks the amplitude of variation decreased greatly and in May the changes were hardly perceptible.

In 1903 and 1905 the variation was again observed, with the same period but smaller range—from $0^m.5$ to $0^m.8$, but in 1907 long and careful observations showed no variability at all. In 1914 the variation was small, $0^m.3$, and in 1916 about the same. In 1919 a large variation of $1^m.5$ reappeared, the planet being four times as bright at maximum as at minimum, but in 1921 the changes again vanished. At the recent opposition they have once more been large, exceeding a magnitude in range.

This seems at first glance a very extraordinary sort of behavior, quite out of keeping with the orderly and reliable progress of astronomical phenomena. But one thing at least has remained uniform: the period of variation has remained constant. The latest determination by Campbell of Harvard is $5^h\ 16^m\ 12^s.94$ and must be correct to a very small fraction of a second.



Courtesy Astronomical Society of the Pacific
Eros has come and gone, now being somewhere near the position of the arrow head in the circle

This indicates that there is really some uniformly recurring process behind the variation. The obvious suggestion that we have to do with a rotation of the planet was made by the earliest of observers and has since been widely accepted. During each rotation there are two maxima and two minima of brightness. This might occur in either of two ways. First, the planet might be spotted in such a way that, as it turned, two light and two dark regions successively occupied the principal part of the visible side. Secondly, it might be irregular in shape. If it were elongated like a cake of soap or a brick, and rotating about one of its shorter diameters, it would alternately appear side on and end on and so change in apparent brightness, even though so remote that no telescope could show it as a perceptible disk, and there would obviously be two maxima and two minima of light in each revolution. The two hypotheses are not inconsistent; the planet may well be spotted as well as elongated, in which case the variation in brightness during a rotation might be complicated with the unequal maxima and minima.

The remarkable changes in the range of variation now find a simple explanation. If the planet's equator is highly inclined to the plane of its orbit—as is known to be the case of Uranus—we, looking from the earth, will sometimes find ourselves above the equator and, again, may be almost in line with the pole. In the latter case, even if we have powerful enough telescopes, we would see Eros as a spotted disk, perhaps of irregular shape, turning round and round its own center but always keeping the same side toward us. There would obviously be no changes in the total amount of light which our telescopes received and if they were not large enough to define the outline of the disk it would look as though nothing were happening.

WHEN the earth lies in the plane of the planet's equator we will see all sides of the latter in succession as it rotates, and get the full benefit of any changes in brightness arising either from irregularity of shape or variations in the diameter of the surface. For intermediate angles of view we will find a gradual change in the range of variation. The effect will always be zero for the observer above the poles but need not necessarily be a maximum for one in the equatorial plane, and of course the brightness of the planet seen from the same distance above its north and south poles may be quite different.

The high eccentricity and inclination of Eros' orbit make its apparent motions in the heavens more varied than those of any other planet. During the last few months, for example, instead of moving east and west like the more conventional planets, it has swept far to the north into Ursa Major and plunged rapidly southward into Hydra. These great changes in the direction of the planet from the earth, or of the earth from the planet, afford exceptional play for the effects which have just been discussed and it is therefore no longer surprising that its variations seems so erratic.

From observations at a sufficiently large number of oppositions with Eros in various parts of the heavens it should be possible to work out the position of the planet's pole and equator. This done, it remains to [illegible] the planet and the spots [illegible] face. Here an ex[illegible] hoped for, since [illegible] to disentangle th[illegible] spottedness. It [illegible] that if we were [illegible] of whatever sha[illegible] matter, colored [illegible] it is possible t[illegible] and paint its s[illegible] such brightness and color that, if the two bodies were set up side by side, illuminated equally by the sun, and viewed from a great distance, they would reflect equal amounts of light of the same col[illegible] direction the[illegible] from direction th[illegible] Photometric[illegible] guishable, [illegible] the spheri[illegible] appears [illegible] moon but [illegible] moon or even a narrow crescent. It might seem, then, that there is no hope at all of determining the shape, but if this is so irregular that one part of the surface may eclipse another, as seen from the earth, or shade another from the sun's rays, the resulting light variation may be such that no possible painting of the surface of the sphere could reproduce it.

To determine from measures of brightness alone whether this was the case, and deduce as much as one could about the planet's shape, would be a difficult problem. Fortunately the recent close approach of Eros provided a solution by the simple process of looking at it directly with a large telescope.

Van den Bos and Finsen, with the 26½-inch refractor at the Union Observatory of the South African Government at Johannesburg, noticed early in February that the disk of Eros was not circular but definitely elongated, so that the planet looked like a very close double [illegible] continuing whenever the state of the sky and seeing permitted accurate observation, and sufficed to fix a rotation period as 0.2195 days or $5^h\ 16^m$, agreeing exactly with that of the light varia[illegible] about 0"18. Since Eros was 16,500,000 miles from the earth, this corresponds to 14 miles.

This quantity probably represents the difference between the longer and shorter diameters. The average diameter may be estimated roughly from the light reflected by the planet, and comes out about 20 miles if we assume a low reflecting power like the moon's, or ten miles if Eros has a high albedo like its sister asteroid Vesta. The great range of brightness which has sometimes been observed, corresponding to a ratio of more than 4 to 1, indicates that the actual elongation is probably of this order. The assumption that Eros is about 20 miles long and 5 miles wide and thick would reconcile the data, provided that the reflecting power of the surface is high. This is of course only a provisional estimate. When the observations of the past opposition are fully worked up and supplemented by a study of those of earlier years we may learn a great deal more.

The investigators who deal with the [illegible] for the shape [illegible] of ro[illegible] the body [illegible] velocity [illegible] form. If these com[illegible] interpretation of the light curves and their changes will demand keen mathematical skill and be just the thing to tempt the enthusiast.

MEANWHILE we may wonder how [illegible] en a small one, could [illegible] ordinary a form. Large [illegible] as the earth must necessarily be almost spherical or, at worst [illegible] ly flattened toward the poles by their rotation. In such masses the gravitational forces in the interior are so great that they would crush the hardest rock and make the stiffest metal yield. A body of irregular shape thousands of miles in diameter would slump under its own weight like a mass of tar on a hot day, until its surface had become almost uniform. But in the case of a small asteroid the gravitational forces are less than a hundredth part as great, while the strength of the materials is the same, and an irregular form, once in existence, should endure.

But how did Eros get its shape? If the planets were formed by cooling and condensation from incandescent matter ejected from the sun one would suppose that each one had finally solidified from a liquid state in which it must have been nearly spherical.

Seeliger, shortly after the discovery of the variation of Eros 30 years ago, suggested that the planet was but a fragment of an older and larger asteroid, split off by a collision with another asteroid at some incalculable date. The asteroids are so small that collisions between them must be very rare, but it is certainly possible that such an event may have occurred. The unusual orbit of Eros, so much smaller than that of any other asteroid, fits in with this hypothesis, suggesting that this particular fragment flew off from the collision in such a way that its motion around the sun was slower than before, making its orbit smaller and bringing its perihelion in close to our orbit.

Similar though less striking variations in brightness have been detected in several other asteroids and a full study may help toward an understanding, not only of the nature of these small bodies, but of the origin of the solar system.—*Princeton University Observatory.*

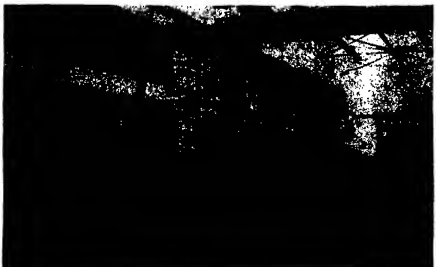


Photo by Oscar S. Marshall

One corner of the recently erected machine shop of the new Astrophysics Department at the California Institute of Technology. In the foreground is Russell W. Porter, who had much to do with its design. The optical shop in which the 200-inch disk will be ground is not yet erected and for other reasons readers may discount stories of the telescope's completion "within two or three years"

THE NATIONAL AIRCRAFT SHOW

By PROF. ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

THE aircraft industry, bent on retrenchment like so many other industries, decided to have but one show this year, the one which has just terminated at the Detroit Municipal Airport. The decision was fully justified. Instead of a number of scattered and uneven efforts, there was one concentrated drive to show the American public what the aviation industry is doing—besides breaking records. The attendance was enormous: 81,000 people paid for admission during the nine days of the show. The public was keen, well informed, and critical but interested. Eighteen percent of the visitors were children under 14 years of age, mostly boys, who collected vast quantities of catalogs and leaflets, asked more intelligent questions than their elders, got in everybody's way, opened and shut all the cabin doors, pulled all the handles and switches they could, generally had a glorious time, and determined to become famous aviators.

In spite of the pessimism from which aviation people are suffering, flying does grow. A total of 505 pilots registered in the "arrival" column of the airport register. On one day 256 landings and take-offs were chalked up.

An aircraft show is not as clearly directed to the public as is an automobile show. From a business point of view, the attendance of dealers, flying school operators, and others professionally engaged in aviation is even more important, and from this point of view, also, the National Aircraft Show was a pronounced success. There were real sales! Seventeen of the 41 airplane manufacturers who exhibited, reported orders for 636 airplanes, valued approximately at 1,652,751 dollars—a figure probably never equaled on any similar occasion.

The industry is chastened, deflated, but on the whole sound and confident. The reasons are not far to seek. There are more and better airports, many rapidly growing transport lines for mail, freight, and passengers. Competition has largely eliminated the smaller manufacturers of planes, and the survivors have a higher standard of excellence in their products. Finally, the American public can now buy better planes, cheaper planes, and a greater variety of planes.

One of the great automobile manufacturing corporations proudly states in its advertising that it has an automobile for every purse, and lists a number of types, sizes, and prices. The automobile, however, is strictly limited in size and general characteristics—four wheels, a wheel base with certain limitations, roads which do not permit extension of weight beyond a certain figure. In the airplane the number of different types is far greater, because no such limitations exist.

Flying—on the ground! A novel training device that climbs, dives, stalls, and banks, but "keeps one foot on the ground"

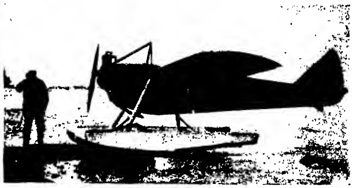
A YOUNG man who has secured his private pilot's license, and feels that he really must have a plane at the local flying field can purchase a small single seater, equipped with a modified motorcycle engine, at an expenditure of less than 1000 dollars, and have a reasonable sport plane at his command. If he wishes to spend 300 to 400 dollars more he can buy a single seater powered with a 45 horsepower engine which will do close to a hundred miles an hour. If he wishes to retain sociability when flying, he can at an expenditure of 1500 dollars purchase an excellent two-seater in which he can offer original and thrilling hospitality to his friends, at a cruising speed of 80 miles per hour. In all three purchases, his maintenance costs will be reasonable, particularly if he is willing to do a little mechanical and inspection work himself.

For 2500 dollars or so, it is possible to get a snappy sport trainer, with an engine of between 75 and 90 horsepower, in which well over 100 miles an hour is obtainable, and with a fuel capacity more than sufficient for cross-country work.

The Lockheed Orion, with landing gear retracted. With full load, this plane can fly at 219 miles per hour

The low-wing Northrop Alpha, with accommodations for six passengers. The pilot's open cockpit is in center

The tiny Heath Parasol plane, one of the smallest in use in America today. It carries only the pilot



The Bull Pup, equipped with pontoons, is an ideal light sport plane for use where water landing places are readily available

Bringing in a Heath Center Wing with "hands off"

Just another few hundred dollars and the flying enthusiast can be the proud possessor of a completely equipped two or three seater, with enclosed cabin, every comfort and accessory, including all instruments, heating, lighting, brakes, and so on.

For a little under 6000 dollars, a well-to-do individual or an enterprising business house can purchase a four-seater sedan, with 200 horsepower to drive it through the air at say 120 miles per hour, which will be the last word in comfort, equipment, and strength. Two- and three-seater amphibions which make the owner free in the air or on land or water, can be purchased within the same price range.

Luxurious air yachts, giant transport planes, sport planes which approach the 200 mile an hour mark, freighters, not of such interest to the general public, but of supreme importance to the air-line operators, give the American airplane a scope and utility which would have been unbelievable four or five years ago.

HERE is what the Heath Parasol, a small plane equipped with a modified motorcycle engine and selling at a price within the reach of a moderate purse, can do: Landing speed 28 miles per hour, high speed 85 miles per hour, with only 27 horsepower at 2700 revolutions per minute. The over-all span is 25 feet, the length 17 feet. A single seater such as this is really handy. The builders of the Heath Parasol have now brought out another small plane with cantilever wings. The pilot is bringing it in, hands off, and having lots of fun if our photograph tells the story.

The Buhl Bull Pup, another small single seater, with 45 horsepower in its Szekely three-cylinder engine, is a three-in-one plane. It can be purchased with beginner, intermediate, and advanced wings, of progressively decreasing area. The beginner can practice with the largest wings which allow him to land very comfortably and slowly. As he becomes more expert he can pass to the intermediate wings, and when practice has made him perfect he can use a set of clipped wings and race at over 100 miles an hour with his tiny craft.

The air flivvers have even put on sea legs. One of our pictures shows the Bull Pup with a pair of small floats. Only a rudimentary beaching rig is required for such a light seaplane, well under a thousand pounds in gross weight, and nothing could be a better medium for thrilling yet safe sport. That the public is interested in the small plane was demonstrated by the many sales of this type.

One of the hindrances to private flying is the comparatively high cost of flight instruction. The Department of Commerce now insists on a ground course and on 10 hours solo flying (solo generally comes after six to eight hours' dual instruction) before granting a private pilot's license. This may mean an expenditure of as much as 500 dollars. Therefore a number of ingenious schools and instructors are reverting to the old days, when part of the instruction was given on "penguins," machines with clipped wings, in which a student could taxi rapidly over the field, learn to control his engine, to make turns, and so on, without actually getting off the ground. A number of different devices for ground training have appeared lately; "trainer," "orientator," "coordinator" are the various terms employed for such apparatus.

Visitors to the show, just before entering the tent outside the main hall, were tempted to get a quarter's worth of entertainment and instruction in the ground trainer shown in one of our photographs. The ground trainer is a fairly accurate reproduction of an actual airplane, complete with ailerons, rudder, and elevators, centrally mounted on a ball-and-socket joint, and provided with a propeller driven by a 10-horsepower electric motor. It is much harder to keep one of these devices on an even keel than at first appears, and the craft *will* persist in diving, stalling, or banking sharply. Our readers are advised to try their skill on such a trainer at the very first opportunity!

THE Lockheed Orion in flight, with its landing gear retracted, makes a wonderful impression. Wings, without a single external brace, blend gracefully into the streamline fuselage. The two-place open cockpit scarcely breaks the upper surface of the fuselage. Around the engine is a Venturi cowl reducing the engine's head resistance to a minimum. The Orion can carry 50 cubic feet of mail or express at a top speed of 219 miles per hour; fully loaded it can cruise for 840 miles at 185 miles an hour. The engine is a supercharged Pratt & Whitney, delivering 450 horsepower at 2100 revolutions per minute.

While this is being written, crack pilots of the British Royal Air Force are grooming their Schneider Cup racers over the waters of the south of England to do 400 miles an hour next September. The racers lead, but commercial designers try to bridge the gap as quickly as they can. An overnight service from New York to Los Angeles is not many years away.

Even in luxuriously appointed cabin planes, phenomenal speeds are being

Harold F. Pitcairn, shaking hands with President Hoover, on the occasion of the landing of an Autogiro on the White House lawn. Collier Trophy on center stand

We have had occasion to describe the Autogiro rather fully in a previous issue, but this photograph gives an exceptionally clear idea of the general appearance of the craft.

obtained. The Northrop Alpha is a beautiful ship, streamlined to the last degree, which can carry six passengers in the utmost comfort, at a speed of 185 miles per hour. The Alpha also points the way in sound, heat, and cold insulation, and in the smooth metal covering of its entirely metallic wings and fuselage. American designers are now finding it possible to displace wood, to have a perfect metal surface instead of rough fabric on their planes, and also to make the thin metal skin, some 15 thousandths of an inch in thickness, give its share of structural strength.

ANYONE who has seen a Ford trimotor (such as the craft permanently exhibited in the waiting room of the Pennsylvania Station in New York City) will have remarked that the metal covering of wings and body is corrugated. Such semi-circular corrugations are intended to give local strength, but naturally they also mean a little more air resistance. The Ford Freighter, like several other modern craft, has a covering of flat sheet dural. Designers give stiffness and strength to the cover by internal stringers or braces, and thereby make their planes both faster and neater in appearance. The pilot's cockpit, with sharply pointed windshield, is at the front just behind the engine.

The Ford Freighter has a span of 70 feet, and with a 600 horsepower, water-cooled Hispano-Suiza engine, it can cruise at 110 miles per hour, although the freight capacity is about 2000 cubic feet.

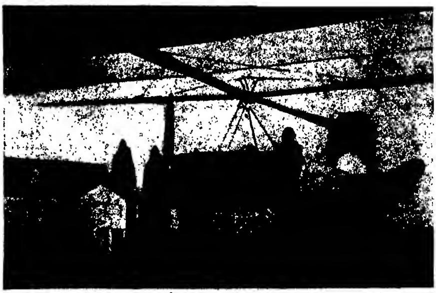
Three days after the end of the Detroit Show, an Autogiro piloted by James G. Ray landed on the south lawn at the White House, just before President Hoover presented the 1930 Collier Trophy to Harold F. Pitcairn for the greatest achievement of the year in American aviation, namely the engineering development of the Autogiro. The space on which the landing was made is only 300 feet in length by 100 feet in width. Ray circled the White House twice and then landed without the slightest difficulty, stopping after a run of 50 feet or so. It is achievements such as this that have convinced the public of the possibilities of the Autogiro for private flying. At the show, visitors exhibited intense interest in the two beautiful exhibits of the Autogiro Company of America. Our photograph shows the smaller of the two models exhibited, the PAA-I, a two-place, tandem cockpit machine, driven by a 125 horsepower air-cooled engine.

IT would carry us too far afield to describe all the splendid engines exhibited by some 18 manufacturers. Aircraft engines are constantly increasing in power for a given weight, and in reliability and endurance, but no radical innovations or changes were in evidence at the show. It was rather surprising to see but one water-cooled engine in the whole vast hangar, the one installed on the Ford Freighter; all others were air-cooled.

A great many of the medium powered engines were of the inverted in-line type. As shown in our photograph of the Autogiro, the in-line inverted type gives the front end of the fuselage a very clean appearance with maximum vision for the pilot.

While much experimentation is going on quietly on the aircraft Diesel, only two engines of this type were exhibited—the Packard and the Guiberson. The advantages of the aircraft Diesel in its ability to use economical, heavy fuel oil have often been dealt with. These advantages assure a bright future for the type. The Packard Diesel is giving a good account of itself in various long flights. A recent improvement in the Packard, of rather too technical a nature to be dealt with briefly, allows the Diesel to be throttled down just like the gasoline engine. This is of inestimable advantage to the pilot in landing.

The dictates of the Editor have made us keep this story short. We have glossed over many examples of the aircraft builder's art, many wonderful devices. Perhaps the reader will be moved to visit the next aircraft show for himself! Such a visit will be well worth while.



A moderate power Autogiro in an exhibition booth at the National Show

THE BIBICAL DELUGE A FACT*

By DR. STEPHEN LANGDON

Director of the Oxford Field Museum Expedition at Kish
Professor of Assyriology at Oxford University

THE remarkable results of the Oxford-Field Museum Expedition to Kish in 1929 have already been communicated to the public. In this article I am able, after having studied the detailed reports of the various members of the staff, to place at the disposal of scholars an accurate survey of the only series of stratifications of a city whose history was continuous from the beginning of history right down to the Parthian period.

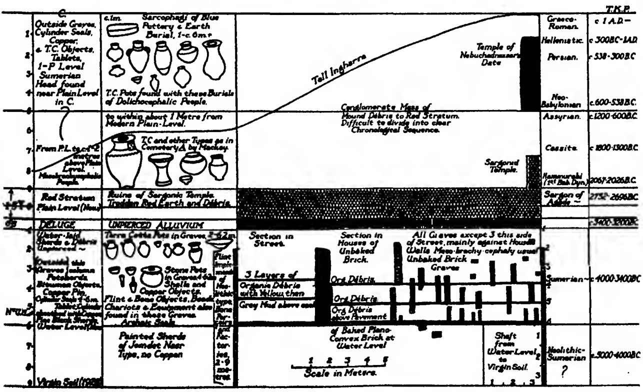
In the center of the illustration at the right, accumulated water is shown. The excavators sank a shaft eight feet square at this point nine feet to virgin soil. Now it is only from the top of this shaft—in other words, 25 feet below the pre-Sargonic period of the red stratum (*circa* 2900 B.C.)—that painted ware is found. It is absolutely impossible to date this period after 3000 B.C. Below the flood level to water level, through 15 feet of débris, there is a continuous civilization, marked by different types of pottery. It is impossible to date the age of any of the painted ware later than 4000 B.C., and the beginning of this city later than 5000 B.C., and perhaps much earlier.

Geological survey may prove that this Flood, on which were founded Sumerian, Babylonian, Assyrian, Aramaean, and Hebrew stories, extended over a greater area of the valley below Kish—for example, at Shuruppak, where Xisuthros built his ark and saved his family from the Deluge. However this may be, the Flood destroyed Kish, and certainly all the great cities of Sumer, which were all on the Euphrates. It was a local riverine disaster, but the civilization above the flood stratum is continuous with that below. There are differences, but these are due partly to the disaster itself, partly to the increasing domination of the Semitic race.

Excavations at Kish corroborate Flood traditions. Alluvial stratum tells of inundation of city not later than 3200 B.C.

The erroneous conclusions on this subject that have been drawn elsewhere, and the length of time before any detailed report will be available, render Prof. Langdon's article welcome.—The Editor.

*Abridged from *The Illustrated London News.*



The Deluge stratum in a vertical section of the Kish excavations, with approximate dates. Plan of the stratification drawn by Mr. C. L. Watelin, head of the excavation staff and Mr. T. K. Penniman, anthropologist. Scale at bottom is in meters

Figure 1: **When the observatory was completed the neighbors all wanted to inspect it, so a formal dedication was held**

AMATEUR ASTRONOMY IN PITTSBURGH

HOW an enthusiastic group of Pittsburgh amateur astronomers, after making their own astronomical telescopes, set out to construct an observatory for their common use, is narrated by Leo J. Scanlon, secretary-treasurer of the Astronomical Section of the Academy of Science and Art of Pittsburgh in an informal communication to the editor.

Figure 2: **Amateur astronomer Scanlon near the eyepiece studying a variable star chart at left**

Some time ago Mr. Scanlon completed a ten-inch reflecting telescope, and mounted it near his home, with the expectation of finding amateur star-gazing an unalloyed pleasure. It soon turned out, however, that the dazzling street lamps of the city interfered with the comfort of this form of outdoor sport, for the eye of the astronomer, before it can function efficiently, must become adapted to the dark and the effect of strong outside illumination is to close the pupil and render the seeing unsatisfactory. "We found," says Mr. Scanlon, "that painting the nearby street lamps black where it did the most good, was no more effectual than their complete annihilation with an air gun, as the lighting company displayed remarkable zeal in changing the doctored globes the following morning.

"A screen of building board was next erected around the telescope and this helped, but it did not eliminate the glare of more distant lamps. The upshot was the proposal to build an observatory which would keep out the extraneous light and also serve as headquarters for our group of amateur astronomers. All we needed, anyway, was a fair excuse to do this, just for the fun of it.

"We speedily completed the plans, made lists of materials, inveigled a local lumber dealer into giving a five percent discount (in the name of the advancement of science) and the makings were on the spot the following Monday morning.

"That evening we laid out the floor joists and bolted them to the concrete foundation slab, upon which a ten-inch reflector had been mounted several months previously. The next evening the studding rose rapidly under the saws and hammers of a dozen willing workers (Figure 3), and just about the time the neighbors began to complain of the din far into the night, all the wooden parts of the observatory were completed.

"A piece of one by one and a quarter inch angle-iron of suitable length was curved to the predetermined radius, and this circle (Figure 4) was attached (Figure

Figure 3: **"The studding rose rapidly under the saws and hammers of a dozen willing workers"**

5) to the woodwork of the square observatory building, the corners of the roof being of course filled in. This served as a fixed track on which the dome was to revolve on rollers.

"We borrowed an electric drill and drilled all the holes in the two-inch angle iron base for the dome proper, and this then had to be bent quite accurately to the shape of a 12-sided polygon, or dodecagon (Figure 6). The web of the angle iron was notched at predetermined intervals, and bent by

Figure 5: **The circul[illegible] permanently attached to the top of the wooden structure**

hand to an angle of 30° at each cut. A welder closed the joints of the angle iron at these notches, after which 12 two-inch rollers, having deep flanges on both sides, were attached to the dodecagon, and as the same photograph shows, it was then hoisted aboard the observatory. It was checked for fit with the track, and found to be true, so it was given a coating of aluminum paint as a protection from dampness.

"When dry, we began attaching to it the tapered aluminum sheets, (Figure 7) previously cut to size, which were to constitute the dome itself.

Figure 7: **The iron polygon shown in Figure 6 was dismounted and the gores were attached one by one**

Aluminum bolts and nuts were used in this process to prevent electrolysis. To assist in curving the sheets to the proper radius, a rigid wooden form was built to fit inside the dodecagon and was placed under each sheet as it was added to the dome.

"Dealers in aluminum sheets were skeptical concerning our hoped-for rigidity of the metal dome, as we planned to omit all forms of internal bracing and let the curved sheets stand for themselves. The dealers predicted that the dome would wiggle like a hula-dancer. As we shall see later, it didn't.

"When we laid out the gores we first calculated the width of the finished gore at each five degrees up along the sector: that is, we figured out 17 separate widths from butt to tip. Thus we knew to a whisker the finished width of each sheet. The sheets as received from the dealer were 40 inches wide and ten feet long be- [illegible] allowed additional material along either edge of the finished width for the seam.

"A simple seam with capping strip riveted on was originally planned, but experts in this field from the Aluminum Company of America advised that the expansion and contraction of the metal would eventually enlarge the rivet holes. We thereupon decided to use a double-turned seam such as is used on tin roofs. The turn-ups were made with a special tool which I made from a pair of blacksmith's tongs and two pieces of scrap angle iron. Later when the sheets were being assembled, these standing parts were double-turned, giving an interlocking joint which added materially to the strength of the dome, having almost equal strength with that of an angle brace of similar dimensions, at the same time giving a perfectly smooth dome inside, without obstructions.

"After the first gore had been bolted to the base and bent over the wooden form, the latter was moved to the next position and the second sheet bent over the form. The seam between the two was held by "C" clamps until the turning operation was completed. It took three of us four hours to fasten and seam the first two sheets, and then we gained speed after a routine had been developed, finishing the dome at the rate of an hour a section. We worked several evenings at this.

"The wooden arcs for the shutter

Figure 4: **The fixed track of angle iron, after being bent, was drilled**

framing and sides of the slot covers were cut to size, and the sheets of aluminum for the covers were bent around them and fastened with copper nails.

"After all of the aluminum sheets were joined together, we had a complete hemisphere. The writer clambered up on top (Figu [illegible] how much 'hula-dancing' the would do, as per prediction. The dor did not live up to the prophecy. V believe a dome of much larger si could safely be constructed in a simil

manner without sacrifice of rigidity.

"Cutting out the opening for the shutter (Figure 9) was as easy as clipping coupons from an eight percent bond. The coaming was added and that part was then complete. The next Saturday afternoon we had a neighborhood 'barn raising.' Eight of us picked up the dome bodily, walked it up three flights of garden steps and on up by way of two planks until it was spotted over the observatory building, (Figure 10) when it was lowered on the track. It was now in position, and it actually revolved. We knew it would, but nevertheless we had to let out a cheer when we saw that all was well and that everything worked as planned.

"With some sash cord and awning pully blocks, we rigged the means to open and close the shutter, both sides simultaneously. There is a two and one-

Figure 8: "Climbed on top to see how much hula dancing it would do"

half inch lap on the shutter joint, which makes it weather-tight and sea-worthy.

"The movable dome does not exceed 250 pounds in weight, and it can be rotated easily with half a hand. The inside of the dome was given two coats of blackboard black, to eliminate reflections. Each of the 12 gores is scaled off with fine white lines representing the network of the heavens, each gore being divided into two hours of right ascension. Parallel circles of declination represent each 10° from pole to S. 20°. About 300 stars, down to the fourth magnitude, have been painted on the inside of the dome in correct relative position and magnitude, with aluminum paint. They are placed with regard to the month labels on the gores so that the stars on the meridian at 9 P. M. in the middle of the month are seen in the correct gore. This was done for the convenience of visitors. The Pole Star is at the zenith of the dome, and the Big Dipper, the Pleiades, Northern Cross, Lyra, Orion, the Sickle, and so on, are easily discernible.

"Around the walls of the observatory are large transparencies, some of them from Yerkes Observatory, some the result of our own efforts, representing conspicuous show objects of the heavens. Each plate is mounted separately in an aluminum box made of scrap material, and lighted from within the box.

"In one corner of the dome there is a desk with dim red lamp, while a still more dim neon lamp is for use at the telescope. A special lamp for use with the variable star charts, adjustable so that the chart can be rotated to correspond with the field in the eyepiece, was also devised from scrap material, and is mounted on a pedestal at convenient eye height, (Figure 2). Charts are placed on the glass face of the box and illuminated by a red globe from within.

"The floor of the observatory is eleven feet six inches clear, with plenty of room for visitors in the corners, where seats are provided. The radius of the dome itself is 70 inches clear.

"THE telescope, (Figure 2) is a ten-inch reflector with circles and slow motions, which was made last winter according to information contained in 'Amateur Telescope Making.'

"Other pieces of equipment available are a sun telescope of 20 feet focal length, which throws large images of the sun upon a white screen, permitting the direct observation of sun spots, or if desired, their photography; also a pair of spectroscopes, a radio set for obtaining time signals, and a pendulum clock.

"You have asked for details of the work and cost. Making the drawings and blue prints consumed about 61 hours, this part being contributed by Mr. E. P. White and two assistants. The total working hours on the wooden parts of the observatory, including all painting, contributed by several of us, was 100 hours. The metal work required 168 hours, nearly all of which was done by Mr. White, the writer, and my brother Larry. The electrical work for general lighting, transparencies, and chart lamp required 14 hours, all of this work being done by a brother, P. A. Scanlon. Other participants in the undertaking were C. B. Roe, president of the Astronomical Section, Warren A. Donaldson, and a brother, N. W. Scanlon.

Figure 9: Cutting out the opening for the shutter was the next thing

"The cost of the woodwork material was 87 dollars; that of the metal 152 dollars; the electrical material 10 dollars—a total of about 250 dollars. This small cost is not a true measure of the fun we have had and still are having. That cannot be measured in dollars and cents."

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As announced in last month's number (page 425) a general "get-together" of amateur astronomers, to which all are welcome, will be held at the observatory described above, on August 8 and 9. Inquiries will be forwarded to Mr. Scanlon if sent in care of The Editor.

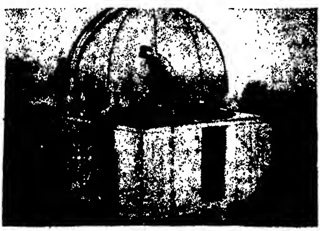


Figure 10: All hands picked up the dome, walked it aboard the building, and tenderly lowered it to position

Figure 11: The job was complete and we all went inside to look it over. Everything worked as planned. We cheered

TELEVISION NOW ON SCHEDULE

By D. E. REPLOGLE
Vice-president, Jenkins Television Corporation

AFTER many years in the laboratory and out in the hands of radio experimenters, radio television today makes a bold bid for public acceptance. During the past three months, the erstwhile experimental television stations have in most instances turned to showmanship in greater or less degree, realizing that the general public is interested primarily in entertainment, once the novelty of snatching pictures out of the air wears off. As a companion move, simple and relatively inexpensive television home equipment has been developed and placed in production, ranging from kits of matched components that may be readily assembled into television receiver and televisor by the average handy man or boy, to complete, ready-to-use receivers and cabinet type televisors for living room use by the veriest layman. The mechanics of television are ready: it is now a question of converting the experiment into an entertainment medium. Can this be done? Upon the answer rests the entire future of the nascent television industry, and in large measure the future welfare of the parent radio industry which sadly needs fresh stimulus today.

BY far the most ambitious showmanship in television is presented by the inauguration of New York's first public television studios. These studios are arranged to pick up living subjects and motion picture films alike, so that programs may never want for available material, together with the sound accompaniment which may be the voice, living music, or musical records.

Two organizations have closely collaborated in bringing "radio talkies" or synchronized sight and sound programs to the homes of metropolitan New York and a considerable section of the outlying country. The Jenkins Television Corporation has supplied the television or sight channel, in the form of the television pick-up equipment and the powerful 5000-watt television transmitter, W2XCR, installed in the same building as the studios. The General Broadcasting System has set aside certain hours during its daily broadcasting schedule for the handling of the synchronized sound component of the television studios, over station WGBS at Astoria, Long Island.

The television studios include the direct pick-up studio and the film pick-up studio. The first is not unlike the usual sound broadcast studio, with the customary acoustic treatment of heavy drapery, and the ever-present microphones. In addition, however, there is the direct pick-up equipment which the performer must face during a television performance. This equipment comprises the scanner, which casts a sweeping

The "flying spot" scanner, using lenses of different focal lengths

beam of light on the subject, and the photo-electric cell banks. The scanner comprises a powerful arc contained in a lamp house carrying an enclosed whirling disk, the holes of which direct the powerful beam on to the subject. Three lenses of different focal lengths are provided, so that the beam may be focused for a close-up, half length, or long shot. Thus it is possible to pick up more or less of the subject without changing the relative positions of subject or scanner, thereby providing a pleasing variety in television presentations. The reflected light from the subject as it is swept by the beam is caught by the photo-electric cells and translated into electrical terms which, amplified millions of times, are sent by wire to the television transmitter for broadcasting purposes.

Meanwhile, the nearby microphone, either in or out of the range of the televisor pick-up, takes in the sound accompaniment which, in greatly amplified electrical terms, is transmitted by direct wire to the remote WGBS broadcast transmitter.

At the home end, two separate and distinct receivers are necessary. The usual broadcast receiver is simply tuned to 1180 kilocycles or 254 meters, bringing in the sound signals. A television short-wave receiver is tuned to 2035 kilocycles, bringing in the pictorial signals which are translated by the televisor into animated pictures. Since picture and sound started in step, they are certain to remain in step when received at the home end.

Radio television, beretofore judged purely as an experiment in flashing little pictures through space, looms big in entertainment possibilities now that sound broadcasters are supplying the essential sound channel. Whatever may be the deficiencies of television today—and they are frankly admitted by sincere workers—the inclusion of the synchronized sound accompaniment makes television showmanship a wonderful possibility from the very start.

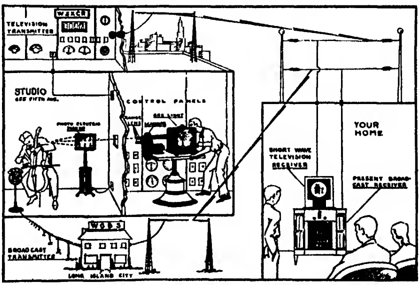


Diagram depicting television transmission and reception, showing how sight and sound are linked. Two complete transmitters and two receivers are necessary

A dynamite "earthquake" in action, with the seismograph crew glued to its instruments, five miles distant

SCIENCE IN SEARCH OF OIL*

IF there is one phase of the business of hunting for oil which has made tremendous strides during the past few years, it is geophysical prospecting. It is characteristic of an age which accepts the greatest miracles of science with the same calmness that it does the workings of the solar system, to fall into an exaggerated concept of the geophysicist's powers.

Undeniable as have been the practical results of geophysical exploration, there is no instrument known to science which can point to the ground and say definitely, "Here is oil."

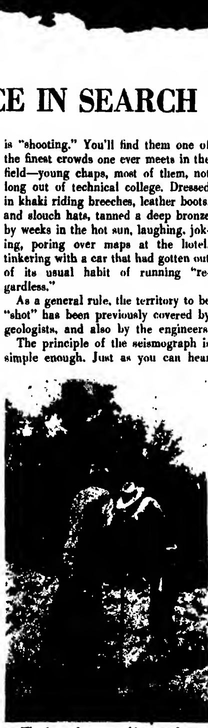
The geophysicist covers very much the same ground as his fellow scientist, the geologist, in that his job is to "dope out the structure" underground and lay it out on the map. The difference is that while the geologist works up his data from observations he can make with his eyes, the geophysicist relies on his instruments. There are many of them, of course. But the three most important, from the standpoint of practical achievements, are the seismograph, torsion balance, and magnet-

TEXAS is the favorite stamping ground of the geophysicist, although he has had some remarkable results in California and Mid-Continent fields. But geophysical instruments are at their best, perhaps, in locating salt domes, and Texas is full of them.

Start out early from Houston some morning and a hundred mile drive will bring you to where the seismic crew is "shooting." You'll find them one of the finest crowds one ever meets in the field—young chaps, most of them, not long out of technical college. Dressed in khaki riding breeches, leather boots, and slouch hats, tanned a deep bronze by weeks in the hot sun, laughing, joking, poring over maps at the hotel, tinkering with a car that had gotten out of its usual habit of running "regardless."

As a general rule, the territory to be "shot" has been previously covered by geologists, and also by the engineers.

The principle of the seismograph is simple enough. Just as you can hear better through a paper partition than through heavy felt, so it is with the various strata of the earth. When an explosion is set off, the sound waves travel down through the ground much as is shown in the sketch on "profile shooting." When they strike a certain stratum, two things happen. Part of the waves are reflected backward, in the same way that light is reflected from a mirror. And part of them pass through the stratum—but at an angle. In other words, they are "refracted," much as light is refracted through a prism.



The dynamite crew making a 20-foot hole into which, after enlargement, 300 pounds of dynamite will be put

Now the geophysicist may do one of two things. He may measure the reflected waves, which come to the surface at or near the point of the explosion, or he may catch the refracted ones, which ordinarily reach the top some distance away, as shown in the diagram. Probably 90 percent of seismograph reconnaissance is done on the refraction principle.

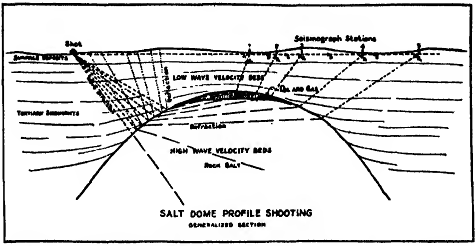
KNOWING the different velocities with which various strata transmit sound waves, the geophysicist can judge from his readings what sort of material lies beneath him, and at what depth. Since the instruments can be placed as far as five miles or more from the shot, considerable territory can be covered in a comparatively short time.

A happier crowd at work it would be hard to imagine. Bright and early the little cavalcade of dust covered cars starts out, trailing behind the chief operator and his assistant, each vehicle with its compact radio and seismic reception sets, its portable aerial mast. Finally they come to the first fork in the road and the party begins to sep-

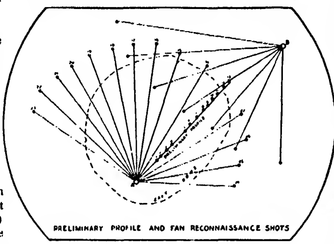
*Courtesy of *The Lamp*. This is the final article of a series of three on salt domes and other sources of salt, sulfur, and petroleum. The previous two appeared in our May and June numbers.—*The Editor*.

arate. The shooter, followed by the explosives car, goes off in one direction, while the operators head in another.

Seismic shooting may be fan-shaped or progressive. In the former, the various operators set up their instruments fan-wise, with the point of the explosion as the handle, as shown in the second of the sketches. Naturally enough, more territory can be covered in this way. Profile shooting, which is used more when the structure has been partially defined and a closer check is desired, consists in setting the instruments one after the other in a straight line from the shot.



Above: How the principle of differential sound velocity reveals hidden rock structures. *Below:* "Fan shooting"



WHILE the operators are getting set up, the dynamite crew is preparing for business. A hole is put down about 20 feet or so with ordinary post-hole augers, and a small charge set off to give a little room at the bottom, so that the force of the explosion will not be expended upward. Then the dynamite itself is tamped down (with a swift nonchalance that makes the layman shudder) and all is ready. Men are posted to keep any stray persons in the field at a safe distance.

Meanwhile, the shooter himself is checking up. All the operators must be ready to take the reading, and there must be no foreign disturbance anywhere that would interfere with the ground waves set in motion. Let's listen in on the radio set.

Number one is reporting. "Say," he calls, "there's a train here that's going around in circles, or something. Wait'll she clears out."

Number two. "All O.K."

Number three. "All O.—hold it! Here comes that old Model T again. Asked him to clear out before. He's rattling like a load of tin."

Four was ready, but number five had the prize "disturbance."

"Give me," he pleaded over the five miles of ether, "three minutes. There's a darkey plowing over in the next field and I'll have to stop him."

When all the operators are ready, down goes the plunger beside the shooter's car, and 300 pounds or so of dynamite explodes with a dull roar. Two readings are taken—one, the speed and direction of the wave through the ground and the other, the air wave, although the latter is not always necessary. It gives the operators the distance of their instruments from the point where the shot went off. The waves are recorded on a negative roll inside the seismic instrument and are developed immediately afterward in a dark compartment—"Turkish Bath," the crowd calls it in hot weather—in the rear of the car.

After the usual check-up following each shot, the cavalcade forms again at the cross-roads, the sweating operators tearing up in clouds of dust to compare notes and check the location of the next shot. Good records are a matter of considerable pride to a seismograph crew, and heaven isn't too good for the chap who consistently turns in clean-cut impressions on his little rolls of developed prints—at least, in the opinion of the unlucky fellow back at the hotel who has to plot the readings, with tables, slide rule, and graph paper, into practical data for the home office.

Field work like this gets into the blood. Big Swede, head operator of this particular outfit, has been at it for years and wouldn't swap jobs with the chief geologist. He knows his crowd, and they get along. Take Shorty, for example.

Shorty is the comedian of the outfit and is particularly distinguished by the number of things he contrives to have happen to his car. Not purposely, you understand. Coming back into town after a hot, dusty day, a tire is just as likely as not to go scouting off his front wheel for no reason at all. This particular time, the tire was obviously past its best days. Shorty had no spare, so with characteristic cheerfulness he hobbled along home on three wheels, the naked rim skidding back and forth across the dirt road until from the distance his car looked like a lopsided crab.

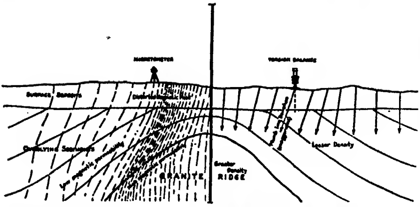
Shorty had the last laugh, at that. For his ingeniousness he got a brand new tire, and a new spare to boot. All he needed now, he explained gravely to the crowd, was a new car and three more tires.

Torsion balance and magnetometer operations are radically different from the chasing about the country which the seismic crew must do. In fact, if you ask a seismograph man, he will tell you in all seriousness that the torsion balance boys are just youngsters whom the company wants experienced and who therefore are allowed to follow him around and go over his readings with their new-fangled toys. If, unconvinced, you seek a torsion balance operator, he will tell you just as solemnly that you cannot locate any salt domes by tearing around the landscape in little cars and shooting off firecrackers. And so forth.

FROM all of which you will correctly gather that each method is equally useful in its own field.[1]

Seismograph work, naturally enough, is better for reconnaissance, since it covers more surface territory at a faster

[1] "Of the total of 158 salt domes [located since 1925], 68 are reported to have been located without the aid of geophysics, 20 by the torsion balance, and 70 by the seismic method. Of a total of 80 domes tabulated by the Department of Conservation of the State of Louisiana for the coastal region of that State, 62 were discovered by geophysical methods (55 by the seismic method; 4 by the torsion balance, 2 by the seismograph and torsion balance, and 1 by the geophone and torsion balance) and only 18 by drilling."—From abstract of an article in *Oil Field Engineering*, which appeared in *Geophysical Abstracts*. All of the methods mentioned in this article are described in detail in Eye and Keys' book entitled "Applied Geophysics."—*The Editor.*



At left is an interpretation of the principle on which the magnetometer works, and at right an interpretation of the torsion balance applied to the same case

clip. The torsion balance, on the other hand, reaches farther beneath the surface and is likewise sensitive to masses some distance from where it is set up.

The torsion balance works on the principle of gravity. Hold a golf ball in your hand and drop it, and you will find it falls in a vertical line, at right angles to the surface. That is because the gravitational pull from the center of the earth normally works that way. The vertical plumb line is an even better example. But suppose the various strata underlying the surface were inclined at an angle, as in a dome or anticline, making a number of dense masses. The lines of gravitational pull would then be warped, and if your plumb were a sensitive instrument, it would tend to hang at an angle, leaning in the direction of the dense mass.

That, of course, is theoretical. Like all other geophysical instruments, the readings of the torsion balance have to be taken, not blindly, but in correlation with other known geological factors. That is why the successful geologist has gray hair on his brain, if not on his head. There is no substitute for experience in the field.

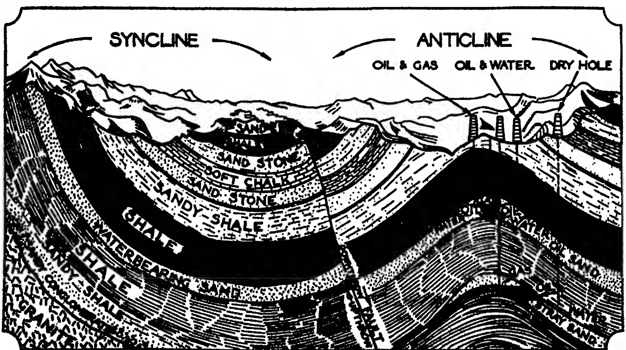
The purpose of the magnetometer is much the same as that of the torsion balance. The entire earth is an enormous magnet. Theories vary, of course, hut just for purposes of discussion we can picture the lines of magnetic force radiating outward from the poles of our magnet. Now, with the exception of certain materials like magnetite which have what is called dynamic attraction, every material which goes to make up the crust acts as a sort of screen or blanket, tending to prevent passage of the magnetic lines of force.

Suppose we consider the various strata as huge screens, laid one above the other. As our lines of magnetic force flow toward the surface, they will pass right through the strata with "coarse mesh," but where they hit a "fine mesh" one they have to "struggle" to get through. Where the bed is extremely impervious to the lines of force (as, for example, limestones, shales, or sandstones), the magnetic lines have to "detour" until they strike a more permeable loophole, such as granite or volcanic rock, through which they crowd. The various types of rock all have their own peculiar ways of "warping" the lines out of their normal course. It is this crowding and distortion of the lines which the magnetometer measures.

The instrument has been used with considerable success in Kansas, Oklahoma, and the Texas Panhandle district, where the structure consists mostly of huge ridges or buried mountains. It is economical under such circumstances, quick and easy to read, hut difficult to interpret. The torsion balance, while it must remain on the spot for a longer time—four hours, or so—and must be carefully isolated from interference, is not quite so difficult to interpret.

THE oil man, like everyone else, is not in business for his health. While both he and the geologist himself realize that the latter is far from infallible, he has found from experience that, given time, the geologist can and does produce results. Every producing subsidiary of the Standard Oil Company (N. J.) has its own geological department and each has its record of achievement.

Some day, perhaps, science may evolve a real "doodlebug" capable of definitely locating oil deposits. Greater miracles than that have happened. But in the meantime geology, geophysics, paleontology, and their allied sciences are doing much to reduce the chances of failure in drilling for oil.



Oil and gas, being lighter than water, often work their way to the crest of a long anticline or ridge in the rocks

A FAMILIAR TRUCK BECOMES A LOCOMOTIVE

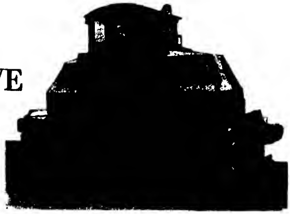
THE locomotives illustrated have been developed by the manufacturers of Mack trucks to perform the work of light steam locomotives now generally used by many large industrial plants to do their switching of freight cars on their own railroad tracks or by other industries such as logging camps, quarries, or steel mills which must move heavy or bulky materials in their manufacturing processes. They are known as gas-electric locomotives and are essentially electric locomotives which carry their own power house around with them instead of collecting electrical current from a third rail or overhead trolley. Electric motors are geared to the axles and turn the wheels when power is delivered to them from electric generators which are driven by gasoline engines.

It is claimed that all the advantages of electric operation such as the absence of smoke and noise of steam locomotives, greater flexibility, improved performance, economy of operation, and increased reliability can be obtained without the expense of putting in a trolley or third rail system.

The Mack company equip their locomotives with gasoline engines that are duplicates of those used in their larger motor trucks. When a locomotive is equipped with more than one engine it may be operated on only one engine when it is doing light work. The remaining engine or engines are started whenever additional power is required, just as in a power house additional turbines and generators are put into operation when the load becomes greater than the capacity of one unit. In switching service this feature is of particular advantage because of the great differences in the number and weights of the cars to be hauled at one time during the day's work. When few cars are to be moved, only one engine is used, resulting in a low fuel cost and in prolonging the life of the engines not required to be in operation.

By selecting their standard motor-truck engines, the manufacturers have greatly simplified the servicing of their locomotives, as replacement parts and mechanics trained to repair these engines are available at more than 100 service stations located in the principal cities of the country.

Two convenient control stations provide fast operation of these gas-electric locomotives with maximum safety. They require no coaling or round-housing. Starting is instantaneous, and power plants are shut down completely during stand-by periods.



One of the two types of 12-ton locomotives; and *below:* Standard Mack engine beneath the hood

A 12-ton locomotive at work in the yards of a large industrial plant

In the cab of gas-electric locomotives, all controls are grouped within easy reach of the operator. Flexibility of operation is one of their strong points

PROFESSIONAL METHODS IN AMATEUR ARCHEOLOGY[1]

IN 1920 the National Research Council organized the Committee on State Archeological Surveys to encourage systematic study of the fast-vanishing Indian remains. In the ten years of its existence the committee has assisted in the formation of research organizations in various states, has sought to systematize and unify methods of investigation, and through publications, conferences, and visits of its Chairman, has endeavored to keep all workers in the field informed of the progress of rcheological research throughout the United State

The activities of the committee have been purely advisory. It has not sought to control the actions of any group or state, but has freely offered its help and ad- 'n the advancer ork. It now seeks , extend its : archeologists and to all who are interested in the early history of our country. In presenting this article, the committee hopes to enlist the active co-operation of all intelligent laymen in the preservation of archeological sites. It seeks to give information which will enable the local investigator to carry on work according to the most approved methods, so that he may assist in unravelling story of human development on the American continent.

IT is evident to everyone that the great majority of our Indian remains have already been destroyed. This has been due in part to the fact that many prehistoric sites have been occupied by white settlers who have found it necessary to level Indian mounds and earthworks in order to utilize the land for farm purposes, for city development, or to make way for roads. However, the greatest destruction has been wrought by curio hunters who have dug into the mounds in search of relics, without realizing that they were destroying valuable historical material. To open an archeological site without knowing how to preserve the record is equal to tearing pages out of a valuable book, a book which can never be re-written.

In each state there are some people who are interested only in securing specimens which they can sell for personal gain. They care nothing for history or science, and are not disturbed by the fact that their ruthless methods destroy materials of great interest to their fellow citizens. This article is not addressed to them. Their activities will only cease when public opinion is strong enough to make their work unprofitable. Today no scientific institution and no well-informed person will purchase archeological material which is not accompanied by a full record. When intelligent local collectors take the same attitude, the work of these commercial "pot hunters" will cease. An Indian relic without data is as worthless as an unidentified postage stamp or bird's egg. The pages which follow seek to show how amateur archeologists may assist in recovering the pre-history of our country, and at the same time help to preserve the existing Indian sites for future generations.

Co-operation With Science

IN April the National Research Council called a conference between scientific men and engineers and others engaged in construction work, for the purpose, as stated in a communication from Professor Fay-Cooper Cole of the Department of Anthropology at the University of Chicago, "of impressing upon commercial excavators the need of careful observation and the prompt reporting of materials uncovered during excavation. There have been many reports of human bones or utensils made by man found associated with extinct animals or in ancient strata. Usually the bones are disturbed before competent scientists can visit the sites, and thus data possibly of great value is lost. Today we have many hints that man may have reached America before the end of the glacial period, but no positive proof. It is hoped that the proposed co-operation will make it possible to solve this question."

The conference was attended by H. G. Clark, chief engineer of the Rock Island Railroad; C. N. Conner, engineer of the American Road Builder's Association; A. J. Moorehead, president of the Madison Coal Company; W. B. Storey, president of the Santa Fé Railroad; A. W. Newton, chief engineer of the C. B. and Q. Railroad, and others.

This is a step in the right direction. The accompanying article outlines further steps toward real co-operation between laymen and scientists in dealing with finds in an effi-

—*The Editor.*

It is well known that some of our Indian tribes were nomadic. They were wanderers who made their camps near favorable hunting grounds and who moved to new sites whenever whim or necessity dictated. Other Indian groups were chiefly dependent on agriculture, and these made permanent settlements which were occupied for long periods. But exhaustion of soil, hostile raids, epidemics, and other causes led to their abandonment and the establishment of new camps. Thus it sometimes happened that a single camp site was occupied several times, and the record of these periods of occupation can now be read by careful excavation. In some places it is possible to carry back the record through successive stages of development from historic to ancient times. Examples of such stratification are rare and should be noted with the utmost care. Through them we can trace the movements of peoples, the growth of culture, and the effects of environment

BUT such a story can n be obtained by the c. less digger, or by those who are interested only in beautiful specimens. It can only be revealed by those who preserve every evidence of this early life. Every potsherd, every implement of bone or stone, no matter how crude or fragmentary, every animal bone or vegetable product, becomes an important part of the record. Nothing should be discarded until it has been made the subject of careful study. Even the scattered surface finds have great value if their location is recorded, for when their distribution is plotted on a map they tell of migrations, of trade routes, and of local development.

In some places the Indians built great earthworks, fortresses and pyramids. In others they constructed mounds of earth in the form of birds and animals—the so-called effigy mounds. In some localities they buried their dead in graves dug in the earth or surrounded them with stone slabs. In other places they placed the corpses on the surface and raised over them mounds of earth, some of considerable size; still others constructed mounds in which they placed the dead. Many different methods of preparing the body were employed. Sometimes it was laid out full length on its back. Again it was placed on its side with hands and feet drawn close up to the body. In some instances cremation was practiced, while still other groups placed the dead on platforms until the flesh had vanished, then tied the bones

[1]Prepared under the auspices of the Committee on State Archeological Surveys of the Division of Anthropology and Psychology, National Research Council: Fay-Cooper Cole, Chairman of the Division (1929-30), and Carl E. Guthe, Chairman of the Committee. Reprinted by permission, with minor authorised changes.

into bundles and placed them in the mounds. All these methods are of extreme interest to the student, and the record of their presence may go far toward identifying the Indian groups in question.

It not infrequently happened that a mound was originally built by a people practicing one method of burial, but was later used by incoming tribes. Such intrusive burials are most instructive in deciphering the sequence of cultures.

Courtesy Department of Anthropology, University of Chicago
Students of the University of Chicago excavating in central Illinois. Note brush and bellows for clearing sand from skull

In the southern, eastern, and far western states, Indians living near to the sea lived largely on shell fish, and during long periods of occupancy built up great refuse piles in which are found animal bones, broken bits of pottery, and other objects which help to reveal the life and habits of the builders.

Cave dwellings are for the most part restricted to the southwestern part of the United States, yet important sites have been discovered in the Mississippi Valley and elsewhere.

WITHIN recent years reports of finds of early man have been current. These range from the finding of utensils associated with the bones of animals now extinct, to the discovery of arrowheads and similar objects lying in undisturbed gravels at points where river erosion or excavation has exposed successive strata. Still other important sites are ancient mines and quarries from which Indians obtained their flint and in some cases copper.

No single collector can hope to obtain a representative exhibit from the whole country, nor would such a collection be desirable, for upon the death of the owner it is almost certain to be scattered and its scientific value lost. However, each local archeologist can become a specialist in his own locality. He can gather the most accurately recorded collection from that area. He can obtain information which when added to that of his fellow workers will ultimately reveal the pre-history of America, and he can have the satisfaction of knowing that he has assisted in preserving prehistoric monuments for future generations.

In many sections of the country it is possible to obtain plat books which give locations of farms, roads, lakes, and other features which may serve as guides in the field. If these are not obtainable, township or section maps may be used, but here it is necessary to transfer from county maps, streams, roads, and other information by which it is possible definitely to locate a site. On such a map first place all existing Indian sites, then those whose former existence can be definitely determined, and finally the approximate location of doubtful sites. In order that all work may be uniform, the symbols shown in Figure 1 are suggested.

Indian trails which can be located from old land surveys, maps, or county histories should be drawn in with blue pencil, but only so far as they can be definitely and accurately identified.

Should there be several mounds so close together as to make it impossible to place them on the map, this can be indicated by placing a number at the lower right-hand side, as, for eight circular mounds: O$_8$. If further identification becomes necessary in describing, letters can be placed above the figures, as O$^{A}_{8}$.

For describing particular sites, squared paper should be used, and the exact location and size of each mound should be noted. Thus each square might be considered as five feet, and the group of mounds O$^{A}_{8}$ might be shown as in Figure 2.

In such a case the use of a tape and compass is necessary to place the mounds in their exact relationship to one another.

When mapping the Indian remains in a township, it is desirable to make surface collections, and to locate the material with relation to the nearest mound, village site, and so on. Such surface material should be carefully numbered and entered in the catalog. Never depend on your memory alone for locating specimens.

Village and camp sites are often located by the profusion of broken pieces of pottery on the surface. Black earth containing charcoal and burned animal bones is also a good indication of former occupation. In places, low circular mounds reveal the foundations of wigwams, while low mounds with central depressions may be the remains of earth lodges.

IN nearly every section of the country private collectors will be found. These may be farmers who have preserved only the specimens found on their property, or they may be those who have collected materials from several townships. In all cases where the owners have any knowledge of the locality from which their collections came, it is desirable to make a record of their specimens. For this purpose it is not necessary to draw in or photograph every piece. First of all, separate the arrowheads into *classes*. Then with a lead pencil trace in the outline of one of each class, and state the number of such pieces in the collection. Or place one of each type on a suitable background, photograph them, and indicate the number of each. Thus, if three classes of arrowheads are found they might be indicated as in Figure 3.

A similar method should be followed for stone axes, hammer stones, and so on. It is desirable to photograph pottery, but if this is impossible, make

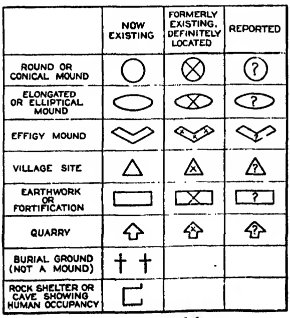


Figure 1: **Map symbols**

drawings, and always indicate the style of decoration if any is present. Also state whether the pottery is sand or shell tempered. Pictures and descriptions of potsherds are also desired. With such information it will ultimately be possible to learn the distribution of type utensils. Local archeologists can render service of great value if they will obtain the data indicated and make them available to the Committee on State Archeological Surveys, or to one of the members whose names appear at the end of this article.

Every amateur who desires to carry on excavation should first of all receive instruction from a trained archeologist. The ability to see the record in the ground frequently depends on training and experience. A beginner, with the best of intentions and with every attempt at care, will often miss stratification lines, or fail to recognize the difference between disturbed and undisturbed deposits.

Your state university or museum, member of the Committee on e Archeological Surveys of the National Research Council, and particularly the institution furnishing these instructions will gladly assist you. *You are urged not to excavate without this instruction unless it becomes necessary to save the record of a site which is about to be destroyed.* In such a case, the following methods should be followed (the letters refer to the points and lines so designated on Figure 4):

RUN a line across the north and south axis of the mound, as line O—O. Five feet to the east run another line parallel to O—O, and continue these five-foot lines until you are well outside the mound. Now, do the same on the west side of O—O. Then, beginning on the south, well outside the mound, run an east and west line C—D. Five feet to the north run another such line, E—F, and continue this procedure until you have gone beyond the northern limits of the mound. Now place stakes at each point of intersection of the lines, and your whole site will be divided into five-foot squares. Before starting work you should make a map of the squares, such as Figure 4. Along the line C—D sink a trench to a depth of about two feet below the surface or disturbed soil. Now carry this trench forward much as you would cut a loaf of bread. Always keep a straight face to the cut, throwing the dirt behind you so as to leave an open space.

As you enter the mound, you may find evidence of a prepared or hard-beaten floor, or of the undisturbed ground upon which the mound was erected. You should be constantly on the watch for fire lines or evidences that the mound was built in two or more different periods. If the primary mound stood for years, and grass and other materials accumulated on the surface, and then at a later time more earth was heaped upon

Figure 2: **Marking locations**

it, this will probably be indicated by a dark or humus line. All evidences of this character should be carefully noted, and your record should indicate the situation for each square. Likewise, every find of a stone implement, pottery, or skeleton should be accurately placed in your plan, and should receive further notice in your field notebook. By following the plan indicated in Figure 4, it is an easy matter to place every object found in its exact place on the map.

Thus such a square as the one

Figure 3: **Types of arrowheads**

marked "I," which begins on the five-foot line E—F and lies east of the zero line O—O, can be written: I-5EO (i.e., it begins on the five-foot line, east of the zero line), while square II-10E5 (i.e., it begins on the 10-foot line, five feet east of the zero line). If an object is found at Ix, it can be written in your notebook as 12.5-W-7, which indicates that it lies 12 feet and 6 inches north of the line C—D, and seven feet west of the line O—O. You should also note in your book how far below the present surface and how high above the floor of the mound the object lies. Each time an east and west line is encountered, as E—F, you should measure the height of the mound from the floor at each

Figure 4: **A typical plot record**

stake. By following such a method, you will have a complete record of the mound, its composition, and its contents. In all excavations test pits should be sunk from time to time below the level of your work, to be si that you are not overlooking some more ancient site. Village sites and cave deposits should be staked for excavation in like manner.

A pick and shovel can be used for the preliminary trench, but when entering the mound it is necessary to use other tools. A mattock with a short handle can be employed for shaving down the face of the cut *from top to bottom*, until objects of interest are encountered, when smaller tools—trowels, dull knives, orangewood sticks, whisk-brooms, and smaller brushes—become necessary.

Never remove a specimen by pulling it out. Always expose the object fully by cutting away material above and on all sides of it, and if it appears to be associated with other objects or with a skeleton, allow it to lie in place until all are uncovered and photographed. Pottery, human and animal bones are sometimes so soft when encountered that they can not be removed without injury, but exposure to the air for a few hours often hardens them considerably. Very fragile bones can be strengthened by spraying them ... thin solution of shellac. Often it is desirable to cut below a fragile object, and slip in a thin piece of wood or tin, on which it can be removed. When working around bones and similar materials, remove the soil by means of thin knives, orangewood sticks, or by brushes. Any object which is worth uncovering is worth preserving. *Unless you are willing to give this time and care to preserving the record, you should not attempt excavation.*

PRESERVE all fragments of pottery and bone; they may be capable of restoration later. Each specimen should be numbered and entered in a notebook. Since tags are easily lost, it is wise to mark each specimen with a 6-H (hard) pencil. Then wrap separately in paper and attach tag to this. When ... potsherds are found together, they may all be placed in a box and properly labeled. Never place pottery, arrowheads, and heavy stone specimens in the same box. Copy all your notebooks, drawings, and pictures in duplicate, and send one copy to your local institution or to the State Archeological Surveys Committee for interpretation and safekeeping. Your interests will be protected and you will be given full credit for any information used.

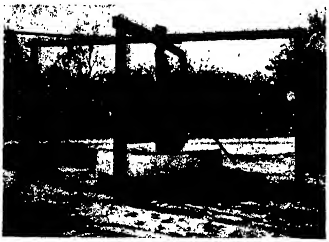
Mention has been made of the possibility of finding evidences of early man

(*Please turn to page 66*)

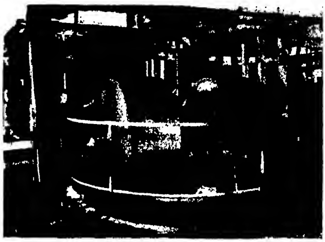
AMERICAN OLIVES BY THE TON

Photographs courtesy *Standard Oil Bulletin*, California

Paraffin-lined vats of fruit, while being processed, are agitated with compressed air. *At left:* Mature olive trees. Olives are hand-picked



A half dozen primitive animal-powered olive crushers are still used by a few minor oil makers in California



All of the large olive oil plants in the state are equipped with geared, mechanically-driven crushers similar to this

IN the mind of the average person, olives are generally thought of in association with the Levant. There has been so much written about them in connection with the shores of the Mediterranean and with Biblical lands, that they just seem to belong there—and there only. In California, however, olive cultivation dates back to 1769 when Padre Junipero Serra brought olive trees from Mexico and planted them at Mission San Diego de Alcala. As other missions were built, each planted its grove and the industry grew finally to commercial proportions. Today there are in California approximately 28,000 acres of commercial orchards with an annual production of 865,000 cases of packed ripe olives, 300,000 gallons of olive oil, 1000 tons of fresh olives that are shipped to the eastern part of the United States for pickling, and from 1500 to 2500 tons of the so-called Greek-cured and Sicilian-cured fruit for American residents who are of Mediterranean extraction.

After the olives are crushed, a hydraulic press expresses the oil fro— the pulped meat which is spread thinly between heavy press cloths

PRESERVED FOR 10,000 YEARS TO COME!

FOLLOWING the great Japanese earthquake of 1923, there was a popular demand that the names of those who lost their lives should be listed and saved for all time in some imperishable form. Newspapers in recent years gave renewed expression to this desire and fixed 10,000 years as the time through which such a memorial should be capable of preservation.

One of the quartz bottles made to keep for ages the record of Tokyo earthquake victims

Ten thousand years! The challenge of that demand impressed itself deeply upon the imagination of a citizen of Tokyo, Mr. M. Yamaki, an engineer of the Tokyo Electric Company, and he began to discuss the possibility with other people. Opinion was general that it could not be done. It was pointed out that in the long history of Japan, the Jimmu Era dating from the accession of Emperor Jimmu was only about one quarter as long and that, practically speaking, 10,000 years is another expression for eternity.

In assembling the earthquake record the scrolls were carefully inserted in four bottles

BUT the mayor of Tokyo at the time of the catastrophe, Mr. H. Nagata, was an ardent promoter of the plan and lent his enthusiastic support. In due course, it fell to the Tokyo Electric Company to undertake the project, and to Mr. Yamaki, himself, was assigned the task of producing such a preservative container as would keep the record intact against the ravages of time.

Mr. Yamaki was advised that for permanence a certain quality of dark blue Japanese paper with the inscriptions in gold paint, such as used in ancient Buddhist scriptures, would be the best. But neither of these materials is available at this time, equal in quality to the old, and Mr. Masaki, President of the Tokyo Art School, recommended white Japanese paper with the names written in Chinese ink. This recommendation was adopted and the paper was specially made of the very best quality by the Government Printing Bureau. A total of 548 sheets, measuring 10.5 inches in width and 27 inches long, were required and their total weight was 22 pounds. Upon these the names of the victims of the earthquake were carefully inscribed. Other sheets bore an explanatory statement by Mr. Nagata, Mayor of Tokyo, a chapter from Buddhist scriptures copied by Mr. Masaki, above mentioned, and the names of those who were associated in producing the memorial.

The problem of protection was twofold: First, to prev eterioration of the scrolls and, second, to safeguard them from mechanical injury. The Society of Resources studied the subject and recommended, as a general plan, that the list be put in a glass bottle, the air exhausted and nitrogen gas introduced, after which the bottle would be hermetically sealed and covered by a lead sheath with a view to burying it in the ground. Mr. Yamaki, while adopting this method in principle, saw the wisdom of certain changes in detail.

He substituted for glass a container made of fused quartz crystal which, although far more difficult to make, had the advantage of less fragility and the ability to withstand sudden and extreme changes of temperature. The choicest Brazilian crystals were chosen and melted in an electric furnace into the form of thin rods like lead pencils. Placed side by side, these rods were fused together one by one in an oxy-hydrogen flame and a bottle was thus constructed 5 inches in diameter and 12 inches long. At the top, the bottle was drawn into a neck so that the heat of the final sealing process would be far enough from the contents to prevent injury. Owing to the difficulty of making one container of sufficient size and strength to carry all the scrolls, four crystal bottles were produced.

The method of inserting the scrolls was to roll them as tightly as possible and push them in through the two-inch opening of the neck. Once inside, the unrolling tendency made them open up to the inside diameter of the bottle, leaving space at the center for additional rolls. The inner surface of a bottle made in this way lacked uniformity of diameter and it was desirable that the scrolls in their released position should be uniformly cylindrical in order to get in the maximum number of sheets. Provision was made for this by placing in the bottle three circular bands of thin monel metal at top, bottom, and center, against which the scrolls unrolled themselves to uniform size. Monel metal, ‹

The asbestos covering of a bottle

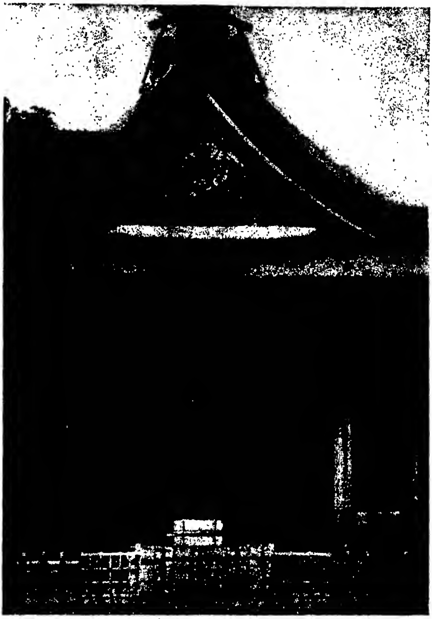
Text and photographs courtesy *The Digest*, International General Electric Company.

alloy of nickel, copper, and iron, was chosen in part because of its resistance to corrosion. Both the top and bottom bands were covered with braided asbestos as a cushion against the bottle, and the middle band was decorated with a black and white silk braid in token of mourning. Both the silk and the braid were very carefully made by the Kuno Shoten in Ginza, using silk sterilized and dyed by Mr. Sampel, engineer of the Silk Examination Station.

After each bottle had been filled, a crystal cover was fused over the top of the neck, the space immediately below being first filled with asbestos. It was then exhausted of air and filled with argon gas, the temperature of the bottle being kept at 80 degrees Centigrade by immersion in hot water. When this process was completed, the gas pressure inside the bottle was approximately equal to atmospheric pressure.

THE next process was to cover the bottle by braiding over its entire surface strips of asbestos over which in turn was a wrapping of asbestos tape. For external protection, the bottle was sealed into a lead container, and this again was put into a fireproof cylinder of Carborundum made especially for the purpose by the Nippon High Grade Furnace Material Manufactory. Because of the extreme hardness of Carborundum, it was difficult to give the outside jacket a polished surface; nevertheless this was undertaken for the sake of appearance and the many points of its crystalline structure were made to shine like mirrors.

The repository chosen for the records toward the preservation of which so much ingenuity, skill, and labor were expended, is an ancient Buddhist temple at the summit of Mount Koya. At this temple, which has a history of a thousand years, the names of the earthquake victims are to remain in a specially constructed hall. The locality is 400 miles distant from Tokyo, and transportation for a considerable distance is by primitive methods. To meet all emergencies of rough handling each container was supported by steel springs within a wooden packing case



At the entrance of the ancient temple on the summit of Mount Koya

Inserting a bottle in its lead sheath

The outside container of Carborundum

It would seem t[...] human ingenuity could [...]rce go further toward in[...]g the preservation of [...]ments for 10,000 years [...]us or minus. Considerin[...] [...]e single item of silk [...] the mourning bands, Mr. Yamaki reflects that there are silk wares today in Shosoin, at Nara, that were made 1200 years ago in the Tempei Era and which have retained their original forms in spite of all unfavorable conditions. He thinks that eight times their life may be reasonably expected of the silken mourning bands which with the other contents have been so sedulously protected. "In my opinion, however," he says, "the possibility of 10,000 years' preservation depends less on the technical features described than on the behaviour of future peoples." And he points to the avidity with which archeologists have delved [...]e personal surroundings of the Pharaohs of 3000 years [...]

Perhaps the pathetic victims of Japan's catastrophe will rest as quietly whether their record comes to light a thousand years hence or four thousand or ten thousand, for humanity instinctively associates its future existence with Him of whom the psalmist wrote: "A thousand years in thy sight are but as yesterday, when it is past, and as a watch in the night."

The world's largest locomotive type sandslinger ramming up a pit mold

MECHANIZING A GIANT FOUNDRY

By J. B. NEALEY

BRINGING the variables under closer and closer control is an ever-present problem in foundry technique. New ideas and equipment with this purpose in view are being constantly devised and put into use. This modernization of foundry practice has been carried on at the two foundries of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, to a remarkable degree.

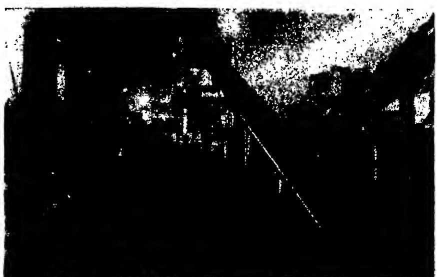
This company manufactures gas engines, steam engines, turbines, condensers, and air and gas compressors, tractors, mining machinery, and many other large unit machines, as well as a large variety of specialty work. The heavy castings are made in No. 1 foundry, which is one of the world's largest. For example, the building of gas engines of 6000 horsepower or more includes castings requiring as high as 125 tons of molten metal at a single pouring.

METAL for the foundry is produced in six cupolas. One of these is for chilled or hard iron which is cast in iron molds, shaped for crusher heads ranging from 5 to 20 tons in weight each. More than eight million pounds of metal can be poured monthly in this foundry, while No. 2 foundry has capacity for five million pounds. All pouring is direct from cupola to flask with the crane service, and ladles running from 1½ to 30 tons are used.

Hand, machine, pit, and loam molding are all employed. Centrally located is a continuous molding unit for tractor parts. The various operations are centered in and about a continuous traveling conveyor, laid in the form of a loop 130 feet long and 40 feet wide. Inside are located a sand conditioner, shakeout stationary sandslinger, and turntable for making up the flasks, in the order named. One of the noticeable things about this unit is the absence of smoke and dirt in the air.

Flasks from the shakeout are put onto a roller conveyor which takes them, by gravity, to the turntable onto which they are transferred as needed. This turntable is equipped with patterns for two copes and two drags. One half the flask is rammed up with the sandslinger, transferred onto the loop conveyor, the core placed with a swing post crane and the other half rammed up and placed on top. The conveyor carries it along to the pouring station opposite the cupolas where the metal is poured.

The flasks travel around the loop to the shakeout station very nearly opposite to the pouring station. The flasks are set on a vibrating shakeout over a grid covered pipe through which all sand and smoke are sucked into a separator, outside the building, where all the dust, smoke, and foul air are removed and the sand dropped onto a traveling belt conveyor. This conveyor runs under the floor back to the molding unit where it meets an elevator conveyor which takes the sand up into the riddle and then into a sand muller. On



Photographs courtesy American Gas Association

The belt in foreground elevates sand to sandarator and hopper over sandslinger. The one in background carries sand from shakeout and separator to sand muller.

the way up the sand passes under a magnet which removes any tramp iron and nails used in the molds. The sand is dropped into a muller from measuring hoppers, where new sand or binder is added; from the muller, the sand drops on to an inclined belt, which drops sand on to a sandarator mounted on top of a 40-ton storage tank. The aerator fills the tank level and aerates the sand. The 40-ton storage tank serves as a feeder for the sandslinger.

As the table revolves under the sandslinger head the molds are rammed. This molding unit will produce 120 castings per day with the labor of but nine men.

IN the center bay is located a 450-foot track on which operates a locomotive type sandslinger with a 27-foot arm for the propeller head. This is the largest sandslinger of its type and was specially constructed for the Allis-Chalmers Company. On both sides of the tracks are rows of pits for pit molding, some as large as 42 by 14 by 10 feet. This sandslinger is also used in ramming up large molds as it goes up and down the track. After the molds are shaken out, the sand is placed between the sandslinger tracks by means of a grab bucket, and the sandslinger prepares the sand for re-use by wetting and riddling. It is then elevated and dropped into the sandslinger hopper feeding the propeller head.

Another track, parallel and located in the east bay, carries two locomotive type sandslingers smaller in size, one of which has a 12-foot ramming arm. The ramming is done on flask molds and the flasks are shaken out between the tracks, the sand to be removed by the sandslinger.

The loam molding section is in the south end of the center bay, and is served with two sand conditioners located in a gallery in the adjacent west bay and over the sand molding department. Giant molds and cores are built up to pattern with sweep boards on immense cast iron bases, the wooden pattern being first set up and a brick wall built to conform to the job. The face of the mold or core is then surfaced with loam or made of molding sand to give it smooth surface.

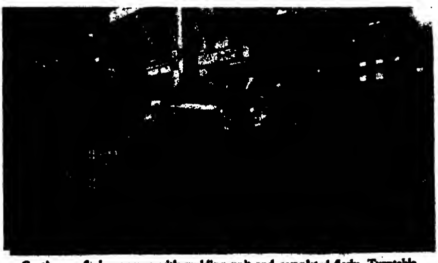
A "bug" or cast-iron ring is now lowered and placed in position aronnd the cast-iron base and another brick shell is built up on this, and outside the first shell, to conform to the outer part of the pattern. When finished, the outer bug and shell are raised and placed on the floor close by to be loam surfaced on the inside. The two parts of the mold are then blackened and placed in giant core ovens, fired with gas, to be baked like cores. After they are baked they are put together ready for pouring.

Continuous molding unit with turntable and patterns in foreground and sandslinger behind

The method of firing is by means of a two-pipe system, using air at approximately one pound pressure; the side burners are supplied with two rows of burner tips while the center burner has but one row of these tips. Stacks, two in number, are located in the top of the oven and are equipped with dampers, while fresh air is brought into the oven and to the burners by air ducts extending laterally and under each burner. This oven consumes about 1320 cubic feet of gas per ton of dried cores, the work consisting of a large variety of sizes.

While there are several core making units, set up at different places in this foundry, mention will be made only of that for tractor cores. Here is located a core sand conditioning machine with overhead bins and automatic scales, the sand being ground with water, oil, and so forth, between steel wheels rotating against a steel bottom plate and revolving about a vertical shaft. The correct amount of oil for each batch is obtained through the use of an air operated valve on the oil supply line which automatically shuts off when the right volume has passed through.

This prepared sand is elevated by bucket conveyor to hoppers which drop it onto belt conveyors which take it to points just over the core makers where it drops by gravity and through chutes directly into the core boxes on molding machines. The sand feed is started and an automatic device shuts off the flow when the correct amount, for the core being made, has dropped into the machine.



Continuous flask conveyor with molding unit and completed flasks. Turntable and patterns visible at extreme right, and sand conditioner in left background

ONE of the unique pieces of equipment in this foundry is a specially designed washer where the cores and sand are forced out of the casting hydraulically and at the same time the castings are cleaned. This machine is housed in a concrete chamber 48 feet long, 20 feet high, and 42 feet wide. The steel top doors and front doors are automatically, electrically operated and the castings are lowered into it with cranes and set on a cast-iron table that revolves. Three stages of nozzles are located one stage above the other and the water from these is played on the castings with the aid of an arm that extends outside the structure. These nozzles are manipulated by men who stand in front of windows where they can observe the play of water as they work. The water and sand flow into settling tanks from which the sand is removed by a grab bucket.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Self-Rescuer for Mines

IT very often happens that when an explosion occurs in a mine, shafts or passageways are blocked so that a number of miners are entombed alive. When this happens and afterdamp is present, the feverish efforts of rescuers are often of no avail because the entombed miners may die of gas poisoning in a short time.

Demonstrating the self-rescuer. Note nose clips and mouth grip

The improved self-rescuer which has been developed by the Mines Safety Appliance Company, gives the miner an extra lease on life despite any poisonous gases that may be present. This small device is a miniature gas mask consisting of a small canister with a mouthpiece directly attached and provided with filters for keeping out smoke and a chemical for transforming deadly carbon monoxide, the poisonous constituent of afterdamp, into harmless carbon dioxide. The mouthpiece is gripped tightly under the lips by pressure of the teeth on lugs, while a small clamp fastens over the nostrils to force mouth breathing only.

The self-rescuer weighs only 14½ ounces and is conveniently carried on the belt—for which a holder is provided—or in the pocket. In the event of a fire or an explosion, a miner wearing a self-rescuer can travel for about 30 to 70 minutes in any concentration of carbon monoxide likely to be encountered.

The United States Bureau of Mines says that "although the self-rescuer does not supply oxygen, it does remove the hazards of carbon monoxide for half an hour or more and thus greatly increases the miner's chances of getting out alive. Thus the self-rescuer is a life saver for the miner and is as essential in mines as life preservers on ships."

Blood Donors

NEWSPAPERS recently reported the death of a blood donor who had provided blood for more than 200 transfusions. In general, the donation of blood is safe, provided too much is not given at any one time or that quantities too large are not taken too frequently. In a recent report of the subject, Drs. H. W. Jones, Herbert Widing, and Lyle Nelson have made a study of reactions to loss of blood in 500 donors who have provided fluid for more than 4000 transfusions. The majority felt improved by the bleeding, the skin seemed clearer, and several with acne reported the disappearance of the lesions. Some who were chronically constipated had normal intestinal function after bleeding.

After a person has contributed blood, he takes a diet rich in meat and green vegetables for the following week. If as much as 400 cubic centimeters or almost a pint of blood is taken, the number of red cells drops about 300,000 red cells per cubic centimeter, and the red coloring matter drops about 4 percent. The average immediate loss of weight is from one half pound to one pound. It was found that women cannot give blood as freely as can men, and that tall, wiry, robust donors between the ages of 30 and 40 stand the loss of blood better than do those who are short, and better than those who are tall but fat. The usual price paid for one gill to one pint of blood is from 25 to 50 dollars.—*M. F.*

First Gasoline Powered Wrecking Crane

A SPECIAL 105-ton capacity, gasoline-powered, Industrial Brownhoist, double-ended wrecking crane was recently demonstrated before a number of prominent railroad officials at Bay City, Michigan. This machine is designed to work in underground tunnels where clearances are close and is the first wrecking crane to be powered by gasoline engines. It will be placed in operation at the Cleveland Union Terminal and a duplicate crane is now being built for the Grand Central Terminal in New York.

These cranes have a capacity of 105 tons at either end and are equipped with three independent power units, any one of which will run the machine. These units consist of two 225-horsepower gasoline engines directly connected to 350-ampere, 400-volt direct current generators and one 208-cell

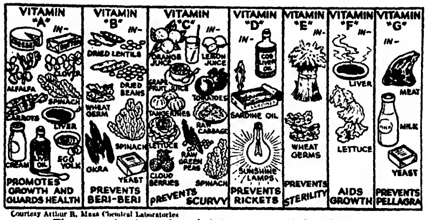
The first gasoline-powered wrecking crane has a capacity of 105 tons

storage battery. All crane movements are electrically operated and the machines travel approximately 33 miles per hour under their own power.

Seven Vitamins—Each Has a Function

THERE is still a great deal to be learned about vitamins and, as James H. Collins points out in a recent issue of *Chemistry and You*, there are still opportunities for commercial development of new ways of utilizing these valuable food adjuncts. Thus, for example, some way might be found to utilize the vitamins now thrown away with the large percentage of trimmings taken from lettuce before shipment. Spinach, carrots, okra, green peas, tomatoes, and other vegetables contain various vitamins. Alfalfa and clover are excellent sources of vitamin A, and while not likely to be popular with people, are important for the health of farm animals, which are important for people.

We are indebted to Mr. Collins for epitomizing the occurrence and functions of seven known vitamins by means of the accompanying illustration.—*A. E. B.*



Courtesy Arthur R. Maas Chemical Laboratories

The seven vitamins, a few of their sources, and their functions

Evade Sugar Duty by Shipping in Solution

A FLAW in the new tariff act has been capitalized by importers of sugar to dodge the duty of two cents a pound levied on raw Cuban sugar. Under the new law, Cuban raw sugar pays a duty of two cents per pound. Mixtures of sugar and water testing from 50 to 75 percent sucrose are dutiable at a rate of 1.7125 cents a pound plus 0.375 cents for each additional percent. But no provision was made for mixing 50 percent and under. So wily importers had their consignments of sugar shipped in solution, claiming that such a product falls under the "sugar syrup" classification with a duty of only one-quarter cent per gallon. The sugar is, of course, crystallized from solution after it arrives in this country.

Raw sugar imports contribute 100,000,000 dollars annually to the duties collected on United States imports. Therefore, this defect in the tariff law may permit the evasion of a very considerable sum unless Congress or the courts take remedial action.

Natural chemistry may also block the practice, for sugar solution inverts rapidly into dextrose and levulose, and cannot be converted back to sucrose; it ferments quickly, particularly in the warm temperatures of the subtropics. One tanker put into Philadelphia with the sugar foaming from the hatches as a result of fermentation. Useless as sugar, the cargo was sent to a distillery where the process of converting the solution into alcohol was completed.—*A. E. B.*

Vacuum-Oiling Eggs to Preserve Them

CHEMISTS in the United States Department of Agriculture have gone a long way toward improving the reputation of storage eggs. A method just developed seals into the egg all of its original moisture and carbon dioxide, so that it will come from storage some months later with all the freshness of youth.

What usually happens when eggs are put in cold storage is that they lose a considerable amount of moisture and carbon dioxide. The more of these constituents lost, the more the quality of the egg is lowered.

Egg shells are porous, but when dipped in oil the pores are sealed. Shippers in the west discovered some time ago that they could dip their eggs in open vessels before putting them in storage and prevent some of the loss of moisture and carbon dioxide. What the Federal scientists have done is to go a step farther and do the oiling in an air-tight chamber, from which some of the air has been pumped.

Surrounded by a partial vacuum, the egg not only drinks up the oil but also gives up a small part of the air it contained. The next step is to turn carbon dioxide into the vessel. With the outside air pressure again normal, the egg draws some of the carbon dioxide inside the shell. As the carbon dioxide penetrates the shell it carries a film of oil with it and forms a seal in the inner membrane.

The vacuum makes it possible to draw nearly four and one half times as much oil into the shell as is possible when the dipping is done in open vessels. After 10 months of storage, vacuum-dipped eggs have lost only 1/10 of 1 percent of their weight, while eggs oiled in open vessels lost 16 times as much, and untreated eggs nearly 27 times as much.

A high grade of mineral oil is used for oiling the eggs, and tests have shown that it does not hurt the quality of the eggs in any way. When broken after 10 months of storage, vacuum-dipped eggs compare favorably with those only one or two days old, and the table quality is said to be just as good.

The process for vacuum-dipping and carbonating eggs was developed by T. L. Swenson and associates in the Bureau of Chemistry and Soils. Mr. Swenson has obtained a public service patent on the process, and already plans are being made to put the plan into operation on a commercial scale.

Preserving eggs by first placing them in a partially evacuated vessel and then giving them a "dose" of carbon dioxide and oil. They are preserved for months

Longest Natural Gas Pipe Line

THE last link in the world's longest natural gas pipe line, which will bring gas from Texas to Chicago and surrounding territory, will be completed about July 1, according to the terms of a contract awarded by the Continental Construction Company to Ford, Bacon & Davis, Inc., engineers. Compressor (pumping) stations, and other adjuncts of the line, will not be ready for transporting the gas itself until some time in the fall.

This last, or seventh, section of the pipe line will extend from Rock Island to Joliet, a distance of 155 miles. Like the rest of the line—950 miles long from Texas to Joliet – it will be 24 inches in diameter. At Joliet it will connect with the pipe line system for distributing the gas to the Chicago district.

Because of the time provisions of the

contract, which put a premium on speed, a large amount of equipment is being used on the job. About 100 tractors, trucks and ditching machines are in service. About 50,000 tons of steel pipe and fittings are being transported and placed in service.

In operation, the pipe line will carry natural gas from the Texas Panhandle to northern Illinois at pressures up to 600 pounds per square inch. To maintain this pressure, 10 compressor stations will be placed along the line. Together, they will have engines of 65,000 horsepower. The largest of these stations—and the largest compressor station in the world—is under construction at Borger, Texas. It will have 12 compressors of 1250 horsepower each.

Above: Diffraction pattern which, by the sharp concentric circles, shows that the crystals are arranged in one direction, giving the steel "directional" properties so that it tends to split with the grain. *At left:* Another sample of rolled steel showing objectionable directional properties. *At right:* After the steel had been properly heat-treated, the X ray revealed a re-distribution of the crystals into a heterogeneous arrangement which eliminates any directional property. This steel is equally strong in all directions

Novel Motorboat Engine

A NEW type of marine engine for small power boats was recently designed by a shop in Maryland.

About six such motors were fabricated by the shop which obtained old four-cylinder motors taken out of scrapped or used cars and cut them in half, as small boats of this type usually employ two-cylinder engines. It was necessary for the shop to make up the extra parts and weld up the half sections. The open end of the water jacket, caused by cutting in two, had to be welded up as well as the cylinder head. The crankcase was also shortened and welded up. These cast-iron parts were preheated by means of a charcoal fire and the necessary welds were made using a cast-iron welding rod. After the preheating, welding, and annealing, the castings were in first-class condition, as a result of observing the correct procedure.

Another interesting feature of this re-designed motorboat engine was that the crank shaft had to be cut in two places in order to re-arrange the throws and then the pieces had to be welded together again. Steel welding rod was used to weld the shaft.—*Oxy-Acetylene Tips.*

X Rays Reveal Minute World to the Chemist

EVERYONE appreciates the value of the X ray in photographing broken bones and recording other internal conditions of the human body necessary for modern medical diagnosis. Only the chemist appreciates the value of the X ray in photographing the "bones" or internal structural arrangements of inanimate substances, for by means of the X ray he has discovered the molecules of matter where distances are measured in billionths of an inch and where the wonders of nature are hidden from even the most powerful microscope.

By passing a beam of X rays through a tiny piece of matter, the expert can obtain a photograph from which he can calculate the size and shape of the unit cells which compose the matter, the structural arrangement of molecules in a compound, the number and distribution of atoms in the molecule, and a dozen secrets formerly hidden from the eye of man, although deduced, in part, by his brain. Thus it is possible to identify an unknown substance, and to study the mechanism of the changes it undergoes as it ages or the existence of internal stresses which affect its physical properties.

While such studies involve a highly complicated and theoretical science, they have a very practical significance. Thus, for example, the quality of steel used in automobiles has been studied by H. V. Anderson, of Lehigh University, who recently presented some interesting results of his work before the American Chemical Society. His studies reveal the reason why steel must be heat-treated after rolling, and give the steel manufacturer a positive check on the efficacy of the heat-treating process. Another interesting investigation by Professor Anderson reveals the internal structure of asbestos and makes clear why one grade of asbestos is superior to another for service as brake linings, for example. The accompanying illustrations show some of Professor Anderson's typical X-ray diffraction patterns.—*A. E. B.*

Milk-Sensitive Babies

THERE was a time when severe skin eruptions of any kind, particularly on a baby, were called eczema. In the last 15 years much more has been learned about the subject so that now eczema has been divided into a number of conditions, including a general pustular infection of the skin, scabies, or itch, and similar disorders. One type of eruption on the skin in infants seems to be due to various sensitivities to food or to similar substances. In one instance a child was found to be sensitive to orris root in its mother's face powder, which developed in the child not only skin eruption but also asthma.

Among the most difficult types are those due to sensitivity to milk. In these cases it is possible to provide for the infant a food combination that does not contain milk, based largely on a combination of soy-bean flour with other substances. Soy-bean flour is taken as the source of the protein, because it is rich in protein and contains the correct amino acids for growth. The formula also contains, in addition to 67.5 percent soy-bean flour, 9.5 percent barley flour, 19 percent of olive oil, 1.3 percent sodium chloride, and 2.7 percent calcium carbonate. Soy-bean flour is defective in calcium, sodium, and chlorine, but contains adequate amounts of magnesium, potassium, and phosphorus. Since this combination is not especially rich in vitamins, orange juice and cod-liver oil are always given as they are given with other types of infant feeding. —*M.F.*

Circuit Breakers to Protect House Circuits

FOR the protection of electrical circuits in the home and for providing at the same time convenient means for restoring service after a circuit has been overloaded and subsequently opened, a small circuit breaker has been developed by the Westinghouse Electric and Manufacturing Company. The use of this device eliminates all dependence upon fuses for circuit protection and avoids the inconveniences of replacement attending their use. This device can also be operated as an ordinary "off" and "on" switch to control the circuits as desired.

The tripping action is not instantaneous, however, but the time of operation of the tripping mechanism is in inverse ratio to the amount of current passing through the device. Thus a small overload, say 10 percent, takes about half an hour to trip the breaker. As the current increases, the time of operation of the trip decreases—always protecting the wire with an adequate margin of safety. A short-circuit causes the device to open the circuit almost instantaneously.

Because of the inconvenience of replacing blown fuses, people are tempted to use fuses

rated at more than the permissable rating of the circuit or to bridge the fuse with a coin or other piece of metal. This situation has led to the demand for a small circuit breaker to protect branch circuits.

The switch is of the toggle type with the fixed center mounted on a swinging arm. This arm is ordinarily latched under a catch on the bimetallic thermal over-current unit or thermostat. As long as this arm remains latched under, the switch operates as any other toggle switch. As the current passing through the thermal unit increases, the bimetallic unit, being composed of two metals of unequal coefficients of expansion, bends more and more until, when the current exceeds a certain limit, it releases the latch; the end of the toggle moves out of line; and the toggle promptly collapses and opens the switch.

Making the time of operation of the tripping mechanism inversely proportional to the amount of current passing permits a slight overload of short duration which would do no harm to the wiring. Therefore, if several electrical appliances happen to be connected on one circuit for a short period of time, the service will not be needlessly interrupted.

Even if the breaker is closed while the circuit is overloaded, it only opens again, tripping free of the handle. Because of this "trip-free" arrangement of the handle, it is impossible to hold the breaker handle closed when the circuit is dangerously overloaded.

A group of these small circuit breakers, mounted on a single panel and located at a central point in a house, provides a convenient method of controlling the branch circuits.

How Physicians Die

DURING 1930, a total of 2943 physicians died in the United States. The average time of death was 63.7 years, a de- of about a year from the average age

of 1929, which was 64.9. The oldest was 97 and the youngest 23. Sixty-six doctors died in automobile accidents, 24 from falls, 8 from gunshot wounds, 5 from overdoses of medicine, and 3 from airplane accidents. One was kicked by a cow and one swallowed a dental plate.

Sixty-six physicians committed suicide in 1930, which was 19 more than 1929. The method most frequently employed was shooting, which accounted for 33 deaths. Seven cut their arteries, and seven took poison; six inhaled gas; four hung themselves; two died through overdoses of drugs, and two by drowning; and one jumped from a high place. These facts, alone, should indicate the temporary mental aberration of suicides, since certainly physicians are informed of relatively painless and certain methods of causing death which they might have used instead of the shooting and hanging routes to oblivion.

Physicians, as do the rest of the public, die in the large majority of cases from heart disease, high blood pressure, brain hemorrhage, pneumonia, diseases of the kidneys, and cancer. Physicians are often asked why their mortality rates are higher than those of the rest of the public and why, in general, they seem to die at an earlier age. The answer should be obvious. They are constantly exposed to all types of weather, they work long hours, and they are in intimate contact with infection.—*M. F.*

American Scientist Gets Unusual German Honor

A MOST unusual procedure in granting academic honors was followed in the presentation at the German embassy in Washington, on April 27, of an honorary Ph.D. from the University of Berlin to an American scientist, Prof. R. W. Wood of the Johns Hopkins University. Professor Wood is on the SCIENTIFIC AMERICAN staff of contributing editors.

It is a very exceptional thing for the degree of Ph.D. to be granted as an honor; it usually follows the establishment of a stated residence and the performance of definite research at the granting university. The University of Berlin, moreover, is very sparing about the granting of any honorary degrees at all, and to confer one on a foreigner at the distance of a whole week's travel from its campus is almost unheard-of. By going to the German Embassy, however, Professor Wood entered what is legally German territory.

The diploma of the degree, which was handed to Prof. Wood, was brought from Germany by Prof. F. Henning, director of the division of heat and pressure of the German Reichsanstalt in Berlin, who is now working with Dr. H. C. Dickinson at the United States Bureau of Standards.

Professor Wood, who has built an international reputation as an experimental physicist, was a graduate student at the University of Berlin from 1894 to 1896. He has been professor of experimental physics at the Johns Hopkins University since 1901. He is recognized as one of the most versatile men in American science, although his chief interest lies in the field of optical physics.

Like Charles L. Dodgson, who achieved fame under the pen-name of Lewis Carroll as writer of the delightful "Alice in Wonderland," Professor Wood has found time to produce some excellent nonsense literature aside from his more serious output. His "How to Tell the Birds from the Flowers" and "Animal Analogues" have a wide and delighted reading public among people who know and care little about optical physics.—*Science Service.*

At left: A sample of good quality asbestos as it comes from the mines shows a definite cellular arrangement which is responsible for the fibrous structure. At right: When this asbestos is heated for 24 hours at 900 degrees Centigrade, it loses its fibrous structure and becomes soft and crumbly. Below: The same fiber, treated with hydrochloric acid, loses its fibrous structure and produces a pattern like an amorphous substance. This is due to the removal of the hydrated silicate minerals of the native asbestos

New Process Used in Making Soft Drinks

FREEZING, to concentrate or to preserve fruit juices for beverage purposes, is developing rapidly, according to an editorial writer in a recent issue of *Food Industries*. The trend closely parallels the trend away from the old style, imitation-flavored carbonated drinks toward genuine fruit flavors for this class of beverages.

A development that is slowly emerging from the research stage into commercial tests is the Heyman process, by which sterile carbonated beverages are produced by pasteurizing before carbonating. Concentrated syrups are heated to pasteurizing temperatures, then measured into sterile bottles, and next filled with sterile boiling hot water under pressure. Still under pres-

sure, the neck space is now filled with compressed carbon dioxide gas and the bottle is capped. After cooling, the carbon dioxide is absorbed by the liquid.

A variation of the process, for chocolate milk, is the addition to sterile bottles, of a hot liquid concentrate made from a mixture of powdered milk and cocoa powder with sugar, followed by filling with water at 260 degrees Fahrenheit under pressure, capping, and cooling at an appropriate rate. Here the temperature is high enough to sterilize the entire contents of the bottle.

The "Electropure" system of electrical

pasteurization, which has been used with success in the dairy industry, is being tested experimentally in the beverage field for the production of sterile fruit juices without impairing the flavor.

Fruit juices are preserved in another way by evaporation in a vacuum at a very low temperature to a thick liquid, which is then mixed with granulated sugar and dried. This gives a crystallized product for shipment to bottlers.—*A. E. B.*

Liver Extract in the Veins

IT has long been recognized that direct injection of remedies into the veins secures more prompt, and in many instances more potent, action than the use of the same remedies taken by mouth, injected into the intestines, or even under the skin. This is particularly true of extracts of the various glands of the body which pour their secretions directly into the blood—the so-called glands of internal secretion.

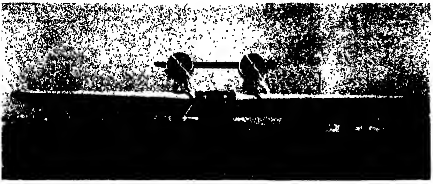
One of the greatest of modern discoveries is the method of prolonging the life of those with pernicious anemia by the feeding of liver. These patients, whose blood is impoverished both as to the number of red blood cells and red coloring matter, promptly improve when large amounts of liver are taken in the diet or when they are given liver extracts of various types. Sometimes, however, they are in such serious condition when they first come to medical attention that every moment of delay may be serious. It is for such cases particularly that Drs. William B. Castle and F. H. Laskey Taylor of the department of medicine in Harvard University Medical School have developed a form of liver that can be injected directly into the veins.

It was found some years ago that the injection of extract of liver promptly lowered the blood pressure; in fact, so promptly that the results were harmful in some cases. It has been found that this lowering effect can be overcome if the material is injected slowly and if the blood pressure is closely watched during the time of the injection. Whereas the feeding of liver by mouth produces a reaction in approximately 10 days, the injection of this new extract directly into the vein produces a maximal response in the form of building of new blood cells within five days. Furthermore, the amount injected is small compared with the total amount that may be fed to the patient.

Investigators in the University of Michigan got a maximal response in 10 days from 3000 grams of liver given at a single dose by a stomach tube. By the new method, maximal response was obtained in five days, giving an extract derived from 100 grams of liver by the vein in one dose. It is significant in medical science that any new discovery is promptly followed by intensive research which brings rapid improvement. Of this type is the continued work on liver extract in pernicious anemia.—*M. F.*

Smoothing Flow Past the Engine

AS we have often pointed out, the radial air-cooled engine, with its projecting cylinders, has a great deal of resistance. Unfortunately, the exposed engine cylinders not only produce drag themselves but also disturb the flow in relation to other parts of the machine.



The plane on which the Townend ring or cowl has been used to smooth the flow past the air-cooled engines. Note also the auxiliary wing behind the engines

In the Douglas Commercial Amphibion, the engines, mounted high above the wing, have around them the now familiar Townend ring or cowl for anti-drag effect. In addition to this, a small auxiliary wing is mounted behind the two nacelles and it is claimed that this also helps to smooth out the flow and to diminish the aerodynamic interference between the engine and the wing.

The Commercial Amphibion with its two Wright 300-horsepower engines, carries a crew of one, five passengers and a useful load of 2395 pounds; and has a gross weight of 8000 pounds, a range of 600 miles, and a top speed of 136 miles per hour.

The wheels are mounted at the ends of what amount to small strut airfoils on each side. This is another useful aerodynamic refinement.—*A. K.*

The Douglas Commercial Amphibion in flight

The Latest in Wind Vanes

THE wind cone or "sock" has one big advantage; when the wind drops, the sock droops. The pilot then knows that there is no tail wind to worry him when landing, with excessive speeds relative to the ground and excessive length of landing run. But he does not know what is the direction of the greatest length of the field, the direction which he should follow on landing. The conventional T-type wind vane suffers from a similar defect. When the wind falls, the T may remain at rest pointing in the direction of the last prevailing gust.

The *Aeroplane* describes an ingenious form of wind indicator which overcomes this defect.

The Martin Wind Indicator is in the form of an arrow about 20 feet long, the shaft of which is in the form of a light girder, with "barb" and "feather" formed of yellow-doped surfaces. The surfaces include both vertical and horizontal areas so that the arrow appears as such from above and from the side, and the bright yellow finish makes it very conspicuous.

The feather or tail surfaces are very much larger than the front or "barb" surfaces, and this serves to keep the indicator pointing into the wind, just as with conventional wind vanes.

When the wind drops below five miles an hour, however, the indicator points into a pre-determined direction. This is achieved in a very simple yet ingenious way. The axis about which the indicator rotates runs in ball-races immersed in oil so that the indicator is very sensitive, and this axis is tilted slightly forward, in a pre-determined direction. The indicator has its center of gravity a little ahead of the axis of rotation. Therefore there is a slight turning moment which causes the vane to rotate into such a position that the center of gravity is at the lowest possible point.

When the wind is too weak to overcome this turning moment, the arrow points in the direction of the greater length of the field.

The arrow is wired for night use with red lights, and the current reaches them through a simple slip ring. Each arm of the main girder is hinged, so that it can be unfastened and folded downwards at the axis when bulbs are to be replaced or minor repairs are to be made.

Why did no one think of this gravitational control before?—*A. K.*

Electrical Construction Equipment for Hoover Dam

THE Westinghouse Electric and Manufacturing Company has been awarded contract for electrical construction equipment of Hoover Dam, part of the Boulder Canyon project. It includes motors and control for driving all electrical shovels, hoists, pumps, conveyors, and compressors; locomotives, switching equipment, circuit breakers, switchboards and transformers, lightning arresters, and meters. A large part of the equipment will be built in the Oakland, California, plant.—*Barron's.*

Aeronautical Meteorology

THE second "Aeronautical Edition of Meteorology" by Willis Ray Gregg, is just as sound and scholarly as the first one, with the addition of much pertinent and practical information.

For example, Chapter II—Instruments and Methods of Observation—has been brought completely up to date.

Pilot balloon theodolites are now in common use for measuring the height of ceilings; that is, the height of the underside of the lowest cloud layer at the point of observation. Accurate knowledge of this height, which is included in all airways observations, is of great importance since the pilot, as a rule, prefers to fly beneath the clouds, rather than to fly blind above.

Measurement of the height of ceiling is accomplished in a number of ways: One is by pilot balloon observations. The height is obtained by multiplying the ascensional rate of the balloon by the number of minutes from the time of release, until the balloon disappears or enters the lower cloud layer. The theodolite has to be used, of course, in conjunction with the balloon. At night a special ceiling light projector is used. This is an electric searchlight which throws a spot of light on the underside of the cloud layer. The height of the light spot is found by the use of a so-called Alidade, a ceiling-height indicator.

A great deal has recently been added to our knowledge of atmospheric visibility, both by outdoor and by laboratory experimentation. The layman is apt to speak of fog in very vague terms. The meteorologist has a very definite scale which is highly convenient to the aircraft operator in transmitting reports. Few of us know that the following accurate scale is now in use:

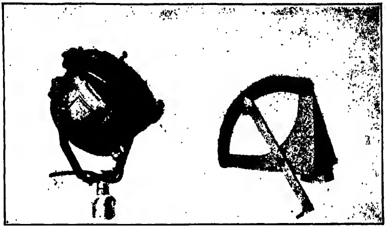
Scale	Descriptive Terms	Limiting Distance
0	Dense fog-prominent objects not visible at	55 yds.
1	Very bad-prominent objects not visible at	220 "
2	Bad-prominent objects not visible at	550 "
3	Very poor-prominent objects not visible at	[illegible]
4	Poor-prominent objects not visible at	1¼ miles
5	Indifferent-prominent objects not visible at	2½ "
6	Fair-prominent objects not visible at	6¼ "
7	Good-prominent objects not visible at	12½ "
8	Very good-prominent objects not visible at	31 "
9	Excellent-prominent objects visible beyond	31 "

The conditions of ice formation are well understood and once understood can be avoided, and Mr. Gregg discusses them fully. Ice increases the air resistance of the wings and exposed parts of the plane, decreases the lift of the wings, and adds to the load.

The increase of drag is due to two important causes: 1. The direct enlargement of wings, struts, wires, and so on, thus opposing greater area to the wind. 2. By the rough or rippled surfaces of ice formation which adds materially to surface friction.

The decrease of lift results from altered wing curvature; the shoulder of ice usually forms first on the upper portion of the leading edge, changing the lift of the airfoil materially, the process being rapidly aggravated by further increase in the size of the shoulder.

Dangerous vibration stresses are also set up by ice. When the propeller blade collects ice unequally, vibration will be particularly serious and may break the airscrew.



Type of searchlight used for spotting the underside of a cloud at night and the Alidade with which is found the height of the light spot

Ice is now being fought by warning the pilots of the conditions likely to lead to ice formation, and by the use of instruments which indicate temperature conditions likely to ...

The book ends with a description of the splendid airways weather service now available in the United States.—*A. K.*

The Martin wind indicator which incorporates several new features

Vapor Lock

RECENTLY in Detroit, Dr. O. C. Bridgeman, Research Associate of the Bureau of Standards, was awarded the much prized "Manley Memorial Medal" given annually by the Society of Automotive Engineers to "the author of the best paper relating to theory or practice in the design or construction of air research on aeronautic power plants or their parts or accessories"—a most formidable definition.

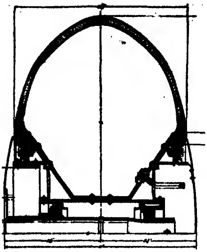
The subject of Dr. Bridgeman's paper was "The Effect of Airplane Fuel Line Design on Vapor Lock."

"Vapor lock" means the interruption in the flow of gasoline from the fuel tank to the carbureter due to the boiling of the liquid fuel at some point in the feed system. (See also page 194, March, 1931 SCIENTIFIC AMERICAN.—*Editor.*)

Vapor lock to the automobilist is merely an annoyance, but to an airplane pilot, it is much more serious. Vapor lock may cause the engine to quit suddenly on a take-off and so induce the dangerous stall and spin. The elimination of vapor lock in the airplane power plant would, therefore, be a real contribution to safety.

Fuel feed systems in the airplane may be divided into two general classes: Gravity feed systems, in which the tank is placed high up in the wing so as to give the fuel a large head above the carbureter; and pressure feed systems, in which a fuel pump is employed.

To eliminate vapor lock in a gravity system, the remedies are simple. The tub-



Manner in which the streamlined tire fastens to the airplane wheel

ing must be large, all unnecessary bends in the system must be eliminated and the piping should have a uniform cross-sectional area throughout its length. Bends in the line trap any fuel which has boiled; that is, any that has been converted into gaseous form. Sudden changes in cross-section of the piping also assist in the retention of bubbles of air or vapor.

The same remedies apply to the pump feed systems in which vapor lock may occur between tank and pump, although not between pump and carbureter.

Dr. Bridgeman's results, while such as common sense alone might have indicated, now put both the causes and remedy of the evil on a scientific basis.—*A. K.*

"Sky Car" Credit

IN connection with the item on William B. Stout's Sky Car, that appeared on page 410 of our June issue, we reproduced a line drawing of the plane under discussion. Due to an oversight in connection with makeup, credit for this illustration to *Aero Digest* was omitted. We take this opportunity to express our regret for this occurrence and to thank our contemporary for their courtesy in the matter.

A Streamlined Tire

THE air resistance of an airplane landing gear may be as much as a third of the whole resistance of the plane, wings not being taken into account. Therefore, designers have made many efforts to reduce landing-gear drag. Some have applied cowlings or "pants" to the wheels. Others have substituted a single cantilever strut for the three conventional landing-gear struts on each side of the fuselage. Others have employed the retractable landing gear in which wheels, struts, and shock absorbers are all made to swing upwards and to disappear inside the wings or fuselage of the airplane. Of course, the most effective method of getting rid of under-carriage resistance *is* to retract it, but this involves a certain mechanical complexity which pilots do not view with favor.

Now the General Tire and Rubber Company have struck out in a fresh direction by streamlining the tire itself. Our photograph shows one of these new tires applied to a low-wing monoplane, and the appended diagram shows a cross-section of the tire. From these two illustrations it can be quite clearly seen that the wheel and tire indeed form a streamline body.

Wind-tunnel tests in the Army Laboratories, at New York University, and at the University of Michigan, show that the resistance of the streamlined tire is unusually low. The streamline form is explained by the fact that the tire has a parabolic shape which blends into the circular portion of the wheel. The new tire is operated at very low pressure, yet owing to its parabolic shape the tire maintains its form very nicely even in rough service.

Another very interesting point about this design is that the bead of the tire is mechanically clamped to the rim of the wheel; hitherto tires have been made tight on the rim by increasing air pressure. The mechanical clamping effectively prevents the tire from sliding around the wheel rim when brakes are applied forcibly and suddenly. This mechanical clamping also prevents the tire coming off when the airplane lands with appreciable side motion.—*A. K.*

Taming Gushers on a Rampage

WILD oil wells—nature uncontrolled—an even ton or more per square inch of pent-up rock pressure abruptly released from its age-old prison and bursting suddenly forth destroying everything in its path! How, asks *The Lamp*, lapsing into the vernacular, do they get that way, and how are they tamed?

Let's watch them bringing in a big well. The rotary bit has bored its way into the earth to the top of the pay sand, according to the geologists' calculations. The long string of drill pipe is withdrawn and next comes the job of setting the final string of casing and cementing off.

With his casing set, the driller now starts his tools down the hole again. First of all —with high pressure wells—he makes sure that there is sufficient mud in his well. The object is that when the well comes in, the weight of the column of mud standing in the hole will be sufficient to overbalance the rock pressure at the bottom so that the well in question may be brought in under control. Sometimes it is necessary to help the mud with a weight loading material. The heavy tools reach the bottom, the driller pulls them out quickly, and the mud is baled out bit by bit until the rock pressure overbalances the weight of the remaining column of mud; and the latter begins to flow out of the hole of its own accord. The monster finally comes in with a roar and the valves are left open for a while until the well cleans itself of mud.

It sounds simple enough. Why, then, the tremendous gushers running wild? Why the rocketing tools, the twisted drill pipe, the mangled valves and fittings?

Carelessness and inexperience are frequent causes of wells getting out of control. More often perhaps it is just a case

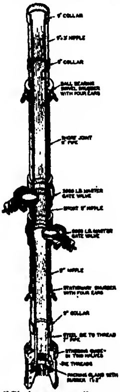
The streamlined tire mounted

of trying to outguess nature and guessing wrong. If geologists figure, for example, that the drill should strike pay sand at 6200 feet, and it drops into a high pressure gas pocket at 6000 feet, the driller is left very much in the position of the fellow who was intently engaged in examining the mouth of a large cannon at the precise moment

C. E. Stout No. 1 well on a rampage, drenching Oklahoma City with oil

some wag chose to pull the firing cord.

In the case of the C. E. Stout No. 1 well, which created such a sensation in the newspapers a few months ago by getting out of control and drenching with oil a large residential section of Oklahoma City, everything went perfectly for a time. The well was brought in under perfect control, but it was then found that the three big 5000-



The "Christmas tree" connection

pound master gate valves did not function properly. Before they could be made to work, the terrific blast of sand and oil under tons of pressure cut right through the partly closed valves like an emery wheel through cardboard. While the well raged, men began working feverishly to replace the broken fittings.

First of all, the sand-cut "Christmas tree" connections (so-called because of the several valves and fittings which protrude from different sides of the affair) were removed. A new Christmas tree arrangement was feverishly assembled and hauled to the derrick floor ready to be placed.

To the onlooker, a Christmas tree looks like an ordinary pipe—a particularly heavy one—with two valve handles protruding near the center. Some of them contain several gate valves and countless nipples, joints, and elbows—as, for example, the complicated "trees" which now crown some of the California wells. Snubbers with rings in them, located near the top and bottom of the piece, afford attachments to which chains may be hooked for hoisting the huge affair.

Inside the bottom of the pipe a steel die collar was fitted, so that the "tree" would cut its own threads as it was screwed over the old casing. A fluted arrangement, as shown in the accompanying illustration, was provided to serve as a guide in fitting the new piece over the casing. When all was ready, the massive affair was hoisted upright by means of a winch and heavy chains and then "stabbed" into the blasting column of oil. Men swathed in oilskins and helmets guided this difficult operation as powerful chains hauled the "tree" into place. The valves were open all this time, of course, so that the gusher continued to shoot through the new connection up into the air, with a goodly amount spraying out the bottom to soak everyone within range. Finally the fitting was screwed down and secured firmly by means of heavy chains and turnbuckles to the legs of the steel derrick. Then the two 5000-pound master gate valves were carefully closed—and the battle was over.

Photographs courtesy The Lamp

Here workmen may be seen working in mud and oil hoisting a new "Christmas tree" near the well preparatory to stabbing it into the wildly roaring gusher

Inspection Gage Accurate to 1/100,000 Inch

LIKE a miniature traffic signal a new Sheffield electric gage in the inspection department of the Reo Motor Car Company flashes green, amber, and red lamps to indicate to the operator whether the part checked is undersize, satisfactory, or oversize. It is the first machine of the type used by an automobile manufacturer and it indicates with certainty any variation as much as one one-hundred-thousandth part of an inch below the low limit or above the high limit of size specified on the production blue print. For each part to be inspected two standards are made of hardened alloy steel and lapped to exact size, one to the high and the other to the low limit of size specified by the engineers. These standards are used by the operator for setting the

Green, amber, and red lamps on this gage tell the operator the condition of the part inspected

electric gage for any new part to be inspected and for checking it from time to time during inspection.

To resist wear the lower end of the plunger is tipped with a selected, carefully lapped diamond and the hardened steel anvil on which the work rests carries a lapped insert of tungsten carbide, a substance ranking second only to the diamond in hardness and selling for over 400 dollars per pound.

Because of its high degree of accuracy this gage proves the most satisfactory device for measuring the standards to which it is to be set for measuring production parts. It is used when the master gages are being lapped to check their sizes against tool-room master gage blocks which in turn are accurate to the millionth part of an inch.

Accuracy of the highest order, however, 's only one of the advantages claimed for this novel device. Increased speed in inspecting and complete absence of eye strain are also afforded. With ordinary limit or snap gages the sense of "feel" of the operator determines acceptance or rejection and with conventional types of dial gages the operator must watch closely and constantly the movement of a hand across a dial and judge whether it stops or passes just below one or just above the other of two limit marks. With the new electric gages the lamp of a certain color lights or it does not light, eliminating the human equation.

Rubber Bearings Lubricated with Water

A RECENTLY perfected method of bonding rubber to metal has made possible the use of rubber for bearings on certain machinery where it is not practical or convenient to lubricate with oil, such as shafts running in water on ships, hydraulic power turbines, sand and gravel pumps, deep well pumps, agitator bearings in chemical plants, and in many other places where water or other lubricants not injurious to rubber are available for lubrication.

Babbitt, bronze, and other soft metal bearings have held undisputed power as bearing surfaces so long that it is difficult to imagine anything taking their places. It becomes easier, however, when one considers that rubber properly compounded

and vulcanized will stand abrasion much better than bronze, babbitt, or even steel.

Cutless rubber bearings consist of a metal sleeve lined with a tough, resilient compound similar in texture to the rubber tread of a high grade automobile tire.

Rubber, like water, is practically non-compressible and is capable of supporting a shaft of great weight with negligible deflection. Another property of rubber underlying its success is its low coefficient of friction when wet. It is commonly known that rubber heels tend to slip when wet and that automobile tires skid on wet streets. In spite of these familiar examples the Cutless bearing is probably the first application of this property in the engineering field. Years of continual use on all classes of equipment up to 30 inches inside diameter have proved the Cutless rubber bearing beyond question to be better fitted for certain conditions than any other bearing now on the market.—*A. E. B.*

Micro-Ray Telephony and Telegraphy

ON the cliffs at St. Margaret's Bay, Dover, England, the International Telephone and Telegraph Laboratories, Hendon, England, in co-operation with the Laboratories of Le Matériel Téléphonique, Paris, France, recently gave a successful demonstration of a new ultra-short-wave radio telephone and telegraph equipment and circuit between Dover, England, and Calais, France. The equipment was largely developed by French engineers in the Paris Laboratories. The demonstration at Dover was conducted by engineers of the International Telephone and Telegraph Laboratories and at Calais by engineers of Le Matériel Téléphonique.

In this demonstration, oscillations of wavelengths as low as 10 centimeters, designated as "micro rays," were used for the first time to provide a high quality two-way radio telephone circuit. From distances covered and results obtained, it was quite clear that the equipment employed can readily be adapted to commercial use. The enormous advance in technique shown by the present demonstration definitely indicates that the range of wavelengths as low as 10 centimeters is now available for commercial radio transmission.

In the demonstration a link had been established between a station on the cliffs of St. Margaret's Bay, near Dover, and a similar station across the Channel at Blanc Nez, near Calais. The two-way radio telephone circuit using a wavelength of 18 centimeters was noteworthy for the quality of speech received. Not only was it well up to the standard of a high quality telephone circuit, but it showed no signs of being affected by fading, a disability from which waves in this frequency are apparently immune.

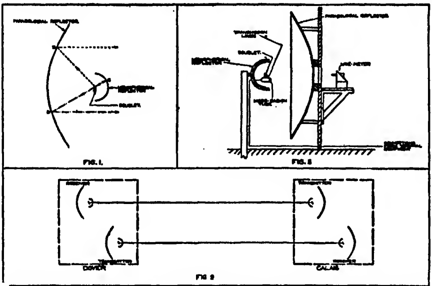


Figure 1: Function of the micro-ray hemispherical reflector. *Figure 2:* Layout of transmitters and receivers in test. *Figure 3:* Cross-section of transmitter

When compared with radiations of the more usual wavelengths, "micro rays" present many striking features. For example, their extremely short wavelength permits the use of electro-optical devices more usually associated with light, such as reflectors or refractors, in addition to diminutive antenna systems. Fog, rain, and such like climatic effects, as well as day and night, do not materially interfere with the propagation of the "micro rays."

The two stations at Dover and Calais were in all essentials identical. Each comprised a transmitter and receiver with terminal equipment of normal design for connecting them together so as to give facilities for two-way communication. The outgoing signals are applied to a "micro-radion" tube in which the high-frequency oscillations are generated. A short transmission line connects the tube to the radiating system or doublet which is about two centimeters long, in contrast to the enormous system usually employed. The amplitude of this high-frequency current along the doublet at any instant is substantially the same. The doublet is situated at the focus of a paraboloidal reflector some three meters in diameter. After concentration of the rays by the paraboloidal reflector into a fine pencil of rays somewhat similar to light rays sent out by a searchlight, they are projected into space. In order further to increase the efficiency of the system by the prevention of radiation other than in the required direction, a hemispherical reflector is located at the opposite side of the doublet to the paraboloidal reflector and having the doublet at its center. This serves to collect all the radiation propagated in a forward direction and to reflect it back again towards the source. The radius of the hemispherical reflector is so chosen that when the reflected radiations reach the focus again they are in phase with those being radiated at that instant.

The function of this hemispherical reflector is illustrated, the effect of diffraction being neglected in this description, although in practice it must be taken into account. It will be seen that the direct radiations such as AB pass straight to the paraboloidal reflector and so are directed towards the distant receiver, whereas waves such as AC are reflected by the hemispherical reflector back through A onto the paraboloidal mirror at D, and so out in the required direction. It is estimated that the gain due to the paraboloidal reflectors on one channel is of the order of 46 decibels to which the hemispherical reflectors add another 6 decibels.

The receiver is a counterpart of the transmitter except that no high-frequency measuring device is provided. That is to say, it comprises a doublet connected by a transmission line to the micro-radion tube where detection takes place. Paraboloidal and spherical mirrors exactly similar to those of the transmitter are also provided for concentrating the received waves upon this doublet.

To avoid coupling, the receiver is situated about 80 yards from the transmitter at each terminal and is arranged to be in its electro-optical shadow, adequate allowance being made for diffraction. The same wavelength is used both for sending and receiving.

Commercial applications in a world-wide communication network like the Interna-

Micro-ray transmitter and receiver at Dover. The receiver is located in the electro-optical shadow of the transmitter so there will be no interference

tional System are obvious. The frequency band available will permit the working of a very large number of permanent and continuous channels between the same places without mutual interference.

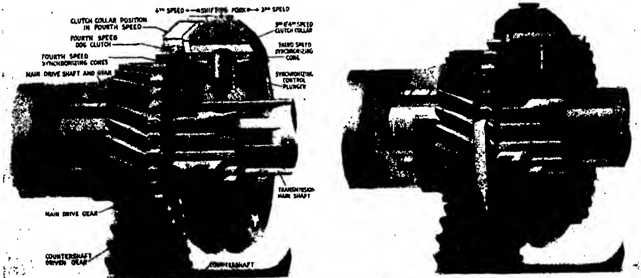
A further very important use will be for television transmission. The present difficulty with regard to television is the very large frequency range required for satisfactory definition of the object transmitted. It should now be possible to allocate as wide a band as is necessary for television without causing any other congestion.

For navigation purposes and especially for radio beacons the simplicity of the transmitters has obvious advantages. Valuable applications seem possible in ship to ship communication, as the small size of the equipment would enable easy use to be made of its directional properties. In addition, the micro ray system affords a satisfactory method for virtually secret communication between war vessels.

How the Synchro-Silent Transmission Works

THE Synchro-Silent gear shift mechanism marks such an important step forward in the attempt of motor-car manufacturers to improve the performance of automobiles, that we have been repeatedly asked for details of this drive. At our request the Graham-Paige Motors Corporation prepared the two illustrations which are reproduced on this page and explained how this transmission works on the Graham Special Six and the two Graham Eights. Incidentally, the manufacturers claim that no other four-speed transmission has a synchronizing device for silent gear changing, and that some four-speed drives lack the all-important feature of silent running in third gear.

In describing the way this mechanism works, it will be necessary to refer to the lettered drawing on this page. When the gearshift lever is moved to engage fourth speed, the shifting fork moves the clutch collar and the synchronizing cone along the splined transmission main shaft until the synchronizing cone contacts with the cone on the main drive gear; the clutch action of the cones then causes the parts to rotate at the same speed. Continued movement of the shifting fork causes the clutch collar to depress the control plungers and slide over the splined synchronizing unit until the internal teeth of the clutch collar mesh with the external teeth of the fourth speed dog clutch, which is integral with the main drive shaft. In shifting to third speed, the units slide in the opposite direction to engage the dog clutch of the spiral (constant mesh) third speed gear which is not shown in the illustration.



Sections of the Synchro-Silent transmission, the action of which is described in the text

New Rustless Iron

IRON can now be aluminized at 900 degrees Centigrade, according to a report of a method developed by Harry Johansson, a Stockholm scientist. The aluminum partly permeates the iron as well as covering the surface, so that the resistive and protective power is great. The Sandviken Iron and Steel Works has acquired the sole rights to the process for Sweden, Norway, Denmark, and Finland for cold-drawn and rolled tubes and cold-drawn band iron. The method is also being tested for the manufacture of kitchen ranges, stoves, ball-bearings, dairy appliances, meat grinders, et cetera. The invention is patented and is being exploited by the Aktiebolaget Stockholms Aluminiseringsfabrik.—*A. E. B.*

Sugar Consumption

PEOPLE of the United States consume more sugar proportionately than people anywhere else in the world, which is strange considering that they also own more motor cars and have more mechanized industry and thereby require less sugar for energy output than people anywhere else in the world. The maximum sugar consumption in the United States was reached in 1926, and the figure was more than 5½ million tons or 109.3 pounds per capita. Assuming that the average food requirement is 2700 calories per person per day, it is estimated that nearly one fifth of the requirement of food fuel in this country was supplied by pure refined sugar. Approximately 16 percent of the total requirement is provided by beet sugar and the remainder by cane sugar.

In 1930, the per capita consumption of sugar dropped to 99.37 pounds. Obviously a drop of 10 pounds per person in a country of 120 million people means the consumption of a great deal less sugar. It may explain partially the campaign now being conducted by sugar refiners to increase the consumption of this food.

In the way of providing energy, sugar is as cheap a form of energy as one can buy. Cane sugar is sold at retail at a price representing 400 calories for one cent, or 2½ cents for 1000 calories. However, man cannot live on sugar alone, since it provides only energy and does not take care of the protein requirement for growth and repair. It does not take care of the mineral salt requirements, including calcium, phosphorus, iodine, iron, magnesium, sulfur, sodium, potassium, and similar elements; neither does it contain vitamins A, B, C, D, and E, or apparently any other vitamins necessary for health and growth.—*M. F.*

Plate Glass Production

PRODUCTION of polished plate glass in the United States in March was 10,592,923 square feet, against 8,881,521 in February, and 10,415,644 in March, 1930.

Molybdenum Increasingly Useful

THE production of molybdenum ore in the United States during 1930, though slightly less than in 1929, was substantially greater than in 1928 or in any preceding year, according to data collected by the United States Bureau of Mines. The production in 1930, as estimated from reports from the leading producers for 11 months' operation, amounted to approximately 6,167,000 pounds of molybdenum sulfide.

Since by far the bulk of the production was used in steel manufacture and since the production of steel dropped off 27 percent last year, it is evident that the production of molybdenum-treated steels increased relative to the total production of plain carbon and other alloy steels. Molybdenum is used extensively in aircraft and automotive steels. To a smaller extent it is also used in various special steels employed in bearings, steel castings, and in corrosion and high-temperature resisting alloys for various purposes.

A substantial outlet has recently been developed in the nickel-molybdenum-iron alloys containing as much as 20 percent molybdenum and capable of resisting the

action of hydrochloric acid. A surprising amount of molybdenum wire and sheet is used in the radio industry. Molybdenum wire, which is made by at least three companies, is used for supporting the filament in incandescent lamps and radio tubes. In the chemical field, a new development of importance is the use of various catalysts, several of which contain molybdenum oxide, in connection with the hydrogenation of oils and especially in the production of motor fuel from the heavier constituents of crude petroleum.—*A. E. B.*

Tire Production Increases

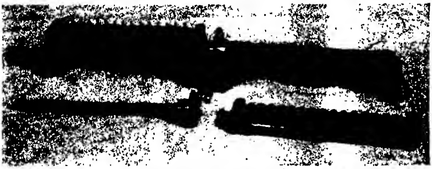
THE Goodyear Tire and Rubber Company has recently inaugurated a 5½-day week in the factory, and increased production from 53,000 tires to 76,000 tires per day.

This expansion in production, which is the third to be made since January 1, reflects the fact that Goodyear sales have substantially exceeded estimates, according to Pres. P. W. Litchfield. "Sales in April will exceed those of April, 1930. We have just completed a survey of tire stocks in the hands of dealers and find them low. Our spring sales have pulled down the company's inventory of tires and it is to build that inventory back to a safe figure that the present production increase was ordered." —*Barron's.*

Short-Wave, Broadcast-Wave Receiver

A NEW combination-wave radio receiver of advanced design and construction, known as the "Universal Super-Wasp," has been brought out by the Pilot Radio and Tube Corporation, of Lawrence, Massachusetts. It covers the wavelength range of 15 to 650 meters without the use of the plug-in coils that have characterized practically all short-wave sets. The shifting from one wave range to another, in seven steps, is done from the front panel by turning a knob. The receiver is available in both factory-built and kit models, for either A.C. or battery operation.

While intended primarily for use on the short waves, for the direct reception of foreign stations, the new instrument is also a good broadcast receiver, and in addition takes in the wave band used for ship-to-shore radio telegraphic traffic.



Close-up of the cam switches used in the universal-range radio receiver described here. *Left:* Completely assembled. *Right:* Showing cams and split housing

Supplied in a handsome walnut cabinet, the Universal Super-Wasp shakes off the laboratory air hitherto associated with short-wave apparatus, and takes on the appearance of a high-grade broadcast set.

The heart of this receiver is a pair of molded bakelite cam switches. Each switch carries 15 thin cams which make contact, in predetermined sequence, with 15 plungers sticking out of the housing like the spark plugs in an automobile. As the switches are turned, they change the electrical connections between four pairs of fixed tuning coils and two double-section variable condensers. There are seven combinations, allowing tuning throughout the following wavelength ranges: 15 to 23 meters, 22 to 41, 40 to 75, 70 to 147, 146 to 270, 240 to 500, and 470 to 650. Any one of these ranges may be selected instantly by a turn of a knob; a scale appears on the front panel to indicate which range is active. The convenience of this arrangement will be apparent to radio fans who have wrestled with recalcitrant plug-in coils and bruised their knuckles against the edges of shield cans.

Electrically, the receiver comprises one stage of tuned screen-grid radio-frequency amplification; a screen-grid detector using a new method of regeneration control that does not alter tuning; one impedance-coupled audio-frequency stage and one 245 push-pull output stage; six tubes in all including rectifier. The A.C. power pack is built on the chassis, which is of aluminum construction, 21 by 11 by 8 inches overall.

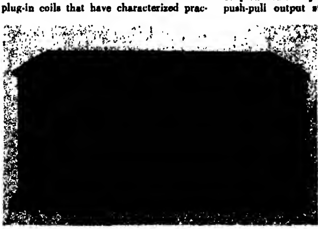
In performance the new receiver is a revelation to people accustomed to the "cranky" operation of elementary regenerative sets. While the receiver itself does not, of course, overcome the distressing undependability of the short waves, it does make possible dynamic loudspeaker results, under favorable conditions, from voice stations in Great Britain, Holland, France, Germany, Italy, Spain, Morocco, British East Africa, French Indo-China, Japan, Java, Australia, New Zealand, Hawaii, Central and South America, and Canada. Stations in these countries have been heard through Super-Wasps and other short-wave receivers.

Summer Camps for Diabetic Children

THE diabetic child was formerly considered an inevitable fatality. With the discovery of insulin it became possible to prolong these lives greatly and already several diabetic children, who would previously not have survived five years, have reached adolescence. Insulin is not, however, a specific remedy for diabetes. Its use is, instead, a substitution therapy whereby the insulin given by injection substitutes for the insulin that ought to be provided by the pancreas of the patient. Hence, the diabetic child must be continually in touch with competent advice.

In the summer when many children go to camp it obviously becomes more difficult to keep such children under good conditions. Several camps have been organized which care for diabetic children. One such camp now provides for 50 diabetic children. A statement of the diet, the insulin requirement, and the complications and condition of each child is obtained from the family physician or the parents six weeks prior to the opening of the camp. The laboratory of the camp begins operating on the same day that the children arrive. Facilities are available for every emergency arising either from too little sugar in the blood or from the diabetic coma resulting from acidosis. Because of the dangers of unconsciousness resulting from too little sugar in the blood following an error in diet or an overdose of insulin, every caretaker carries several wafers of dextrose which can be given immediately and which will overcome the difficulty. All of the food is weighed and each child's place at the table is labeled.

Exercise must be carefully controlled be-



Front view of universal receiver

Interior of the radio set

cause it uses up sugar. The expense appears to be 20 dollars per week per child, and the continued operation over several seasons indicates the success of the work.—*M. F.*

A New Composite Movie Process

ONE of the most important factors in modern photoplay production is the ability to impose one scene taken at one place and time upon another scene taken at another place and time, and so combine the two in such a manner as to create the illusion of simultaneous photography. This ability permits the creation of motion pictures that otherwise would either entail prohibitive expense or make the effort impossible. Such an imposition as that referred to is usually known as composite photography.

A 17 year old schoolboy, Dodge Dunning, son of Carroll Dunning, former vice-president of the Prizma Color Process Company, has worked out with his father's aid, a new process of true composite cinematography, now known as the Dunning process, and obtained a United States patent upon it. During more than two years it has been in general use in the larger California studios and I have yet to find a motion picture photographer who can detect its use.

Prior to this all efforts at composite photography left either obvious gaps between introduced figures and background, or produced what was called "phantom"; an effect in which either figure showed through background, or the reverse.

Suppose that a Hollywood studio has a story in which a group of a dozen characters, by twos, threes and fours, must walk up the steps of the National Gallery in London and disappear within while the traffic of London proceeds. The procedure is for an order to be given a London cinematographer to photograph such a number of feet of the National Gallery and to ship the negative to Hollywood. Arrived there the necessary action pertinent to the story is photographed by the Dunning process and coupled with the London negative.

In the picture "Anna Christie" all the interesting harbor scenes were photographed from a tug boat on the East River in New York, but the characters played by George Marion, Greta Garbo, Marie Dressler, and Charles Bickford were introduced a month later in a studio in California, and no one has complained of the quality.

Technically the process is simple, being based on the separation of color values. Probably had color photography never been achieved there would have been no Dunning process. The procedure is this:

First an original background scene of the desired character is supplied by the motion picture studio. How or where it is made is of little importance. It can be an actual, full-scale scene; a miniature or model scene; something culled from a "library", or anything of similar nature. Whether it contains action is also immaterial. Next a double-image transparent print is made from this negative, containing a positive image of red shade and a negative image of neutral gray. Experimentation determines the exact degree of density of this double-image print necessary to "fog" an unexposed panchromatic film placed behind it in the presence of white light.

An ordinary motion picture camera equipped with double magazines is then brought into use, and into this is put unexposed panchromatic negative with the double-image print in contact with it and in front of it. Plainly this furnishes a mask. Now the new action that it is desired to introduce is posited before a plain blue background. By lighting the figures, and such accompanying objects as are to be included, with a strong white light which is neutral to both colors of the transparent double-image print, and strongly illuminating the blue background with high intensity flood lights, the double-image print becomes a filter passing through itself the reflected white light from the new foreground action, while the reflected blue light from the background acts as a printing light that imprints the detail of the double-image print on the unexposed negative at the same time. Both images are photographed *together*. Thus phantom or surrounding lines or gaps, are impossible, and the result is a true composite photograph. This is developed and printed in the usual manner.

Now that sound is rampant in the film industry this process is peculiarly useful, for it permits separation of action and their later conjunction. Suppose that it is desired to record a bit of dialogue occurring on a busy street corner. Ordinarily it would be impossible because of the roar of the city traffic and the extraneous sounds the microphone would pick up. But it is easily feasible to shoot the street corner with all its racket, and then, returning to the studio, record the action and sound of the dialogue, and by the Dunning method combine the two, holding down the street noise to the point where it does not interfere with the clarity of the dialogue.

Actually any negative produced by this system is a "duped" negative, but the art of "duping" has now reached such perfection in Hollywood that it is difficult to tell a dupe from an original. There are many so far unsuspected possibilities in this method of composite photography, which may be expected to permit extraordinary results and a great economy in production. —*Campbell MacCulloch.*

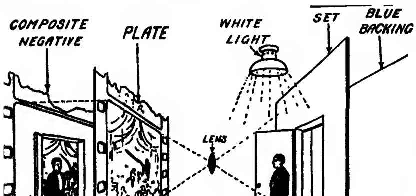


Diagram of Dunning composite movie process, described in text above

Fire-Resistant Motion-Picture Screens

IN their ceaseless efforts to reduce hazards, theater operators have repeatedly demanded a fire-resistant motion-picture screen material. Such a product is now announced as among the latest developments of the du Pont laboratories, according to E. H. Nollau, in a recent issue of the *du Pont Magazine.* Scores of formulas were compounded and discarded as unsatisfactory. Finally a new material was developed which has withstood rigorous tests both by the manufacturer and the Board of National Fire Underwriters.

Testing fire-resistant movie screen

Aside from the all-important fire-resistant feature, this new, approved motion-picture screen material has the advantages of a matte finish, which gives a highly uniform degree of reflection and a construction which permits of easy and clean perforation when the screen is to be used for sound projection.—*A. E. B.*

Frosted Foods in Wide Favor

GENERAL FOODS CORPORATION and Standard Oil Company of California are forming Pacific Frosted Foods, Inc., for commercial development of the Birdseye

quick-freezing patents in Pacific and western states. Standard Oil Company of California is interested because of its management control of the Pacific Public Service Company, which already has extensive interests in refrigeration. Through its subsidiary, Frosted Foods, Inc., General Foods Corporation has been engaged for the past two years in the experimental development of the patents on the Atlantic seaboard.

Pacific Frosted Foods, Inc., will hold the rights to the basic Birdseye patents in California, Oregon, Washington, New Mexico, Arizona, Colorado, Utah, Montana, Wyoming, Idaho, Nevada, western Mexico, Alaska, and Hawaii.

"One year's experience in stores in New England has demonstrated the practicability of the idea from every angle," reports the General Foods Corporation. "In New England the public, through its high percentage of repeat orders, has shown its acceptance of this new method."—*Barron's.*

Home Canners Warned to Guard Against Botulism

THE recent case of food poisoning in North Dakota, in which 12 persons died from eating home-canned peas, has prompted the United States Department of Agriculture to call attention again to a method of canning non-acid vegetables in the home to guard against the deadly botulinus poison.

The bacteria that cause botulism are abundant in many soils. Some may be present in most soils, and consequently may be on the vegetables to be canned. When these bacteria germinate in a closed container they form a deadly poison. They will not grow in salt solutions, however, if the percentage of salt is higher than 9 percent and they will be killed at boiling temperature if the solution is sufficiently acid.

In the canning of non-acid vegetables—peas, asparagus, beans, corn, beets, and spinach—the only safe course is to destroy all bacteria that may be present by canning under steam pressure, according to the Bureau of Home Economics. In the case of acid vegetables and fruits, such as tomatoes, apples, peaches, and gooseberries, the bacteria are killed at boiling temperature (212° Fahrenheit); but with non-acid vegetables there is no assurance that the botulinus organisms will be killed by processing in boiling water unless the material is heated for six hours or longer. Obviously, a six-hour treatment of peas or similar vegetables would result in a very unattractive product. A much shorter heating time is required at a temperature of 240° or 250° Fahrenheit such as may be obtained in a pressure cooker.

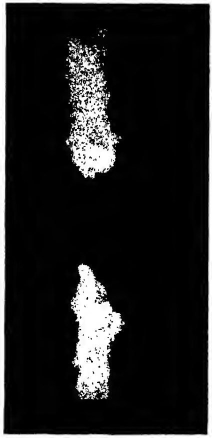
Pressure cookers are now standard equipment and are readily available at small cost. The department does not recommend any particular make, although it emphasizes the importance of having the pressure kettle equipped with a thermometer and pressure gage for proper control. There is now no excuse, the department says, for continuing to take risks involved in canning non-acid foods without adequate pressure cooking or curing or acidification.

Ordinary types of spoilage may usually be detected by the odor or appearance of the can or its contents, but the botulinous toxin may be present without any signs of spoilage. If present in small quantities this toxin is destroyed by boiling, according to the Bureau of Home Economics; therefore it recommends that all home-canned vegetables and meats when opened for consumption be boiled for at least 10 minutes before they are tasted.

Science "Knocks Out" Lightning Bolt

ENGINEERS recently shot enough electricity through an experimental lightning-rod to lift the Woolworth Building off its feet.

The giant "spark plug" at the new Westinghouse high-power laboratory blazed into action for the first time as over 132 million



Above: Preparing t_ ..... _ new lightning rod with "man-made" lightning. *Right:* The bolt has landed but the Torok lightning rod has delivered a knockout blow

volt-amperes leaped across the terminals to the lightning-rod on test.

There was a burst of flame from each end of the rod and a report like that of a six-inch cannon as the experimental lightning-rod "knocked out" the terrific lightning bolt in less than 1/600 of a second.

"The results of the tests are so promising," said J. J. Torok, Westinghouse lightning wizard and inventor of the rod, "that we are working night and day to finish its development as rapidly as possible.

"We hope it will effect greater economies in present forms of flashover protective devices now in service to protect insulator strings on overhead transmission lines which supply cities with light and power. In addition, it is expected to provide permanent protection against the ravages of lightning and save the country millions of dollars a year.

"Now, after a lightning stroke, protective devices of the fuse type must be replaced. This requires constant patrolling of the lines. Because of the limitations of a single line, duplicate lines must be constructed. The new lightning-rod does away with this expense."

Its construction is simple. It consists of a tube about the size of a lady's umbrella. A piece of metal at each end serves as an electrode to entice the lightning inside for the "knock-out" blow. It is supposed to work so fast that the lights in a house will not even flicker.

This device, technically known as a "De-Ion" lightning protector, is used to protect insulator strings on transmission lines against flashover.

Engineers have estimated that if the Torok lightning-rod is as successful as it promises to be and had been available 10 years ago, the world would have saved a hundred million dollars.

High Blood Pressure

THE exactitude of blood p terminations has caused ins panies to take this measurement ... the most important factors in determining whether or not life insurance will be granted to any applicant. Doctor David Riesman has just reviewed the present medical attitude toward this subject. Whereas he used to be greatly distressed as to the patient's prospects when a blood pressure of 180 or higher was found, he now feels that there are many things worse than high blood pressure, because many patients with high blood pressure survived others for many years and enjoyed good life diminished vigor. Of course, n patients with high blood pressur fortunate. The insurance statistics show that the mortality among people with high blood pressure far exceeds the normal death rate.

It must be recognized to begin with that there are various types of high blood pressure. There are also certain factors that seem to be common to most of the patients. They appear to have had a great deal of

(*Please turn to page 63*)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

ABOUT 30 years ago Professor Elihu Thomson, working entirely as an amateur like the various amateurs whose telescopes have been described from month to month in this department, made a ten-inch objective lens and mounted it in a telescope which is still in operation, as shown in the illustrations. As practical instructions concerning objective lens making are not plentiful we invited Professor Thomson

Professor Elihu Thomson

to put his experience in permanent form, regardless of the fact that the work performed was not recent. This he has done from his original notes, and the article is reproduced below.

Professor Thomson's activities have been almost legion but he never has forgotten that he is an amateur telescope maker, one of the kind described by Professor Hale in "A.T.M." (page 180). At present he is "amateuring" a rather larger job than any amateur seems likely to tackle for some time to come—the fused quartz disk for the 200-inch telescope. However, most of Dr. Thomson's activities have been in the electrical field. He is one of the founders of the General Electric Company, and is the recognized "dean of electrical engineers." He has taken out more than 700 patents, the third largest number granted to any individual. His account is as follows:

"AFTER having acquired experience in the making of two or three smaller objectives, including one of eight inches aperture, I determined about 1899 to construct a telescope of ten inches aperture, and mount it in a suitable observatory building.

"To this end, I obtained two guaranteed disks of glass made by Mantois in Paris, from their agents in New York. These disks of flint and crown glass respectively were 10½ inches in diameter. The crown glass disk had a density of 2.543, and the index of refraction for the D line (sodium) of the spectrum was 1.51709; (A line = 1.51139; C = 1.51446; F = 1.52335; G = 1.52848; mean dispersion C to F = .00892). For the flint glass disk, these values were: D line = 1.62842 (A = 1.60621; C = 1.61158; F = 1.62842; G = 1.63866; mean dispersion C to F = .01684).

The objective lens (not to scale)

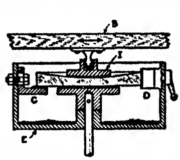
"It was decided to follow a form given by Steinheil, which gave a focal length of 135 inches, approximately, the flint disk to be the outer one. R_1 surface is convex, R_2 concave, R_3 convex and R_4 convex.

"Four disks of heavy plate glass (porthole glass) were secured for grinders, and a machine driven by a small electric motor set up with means for reciprocating an iron grinder for roughing, and below this on a vertical shaft, a face plate about 7½ inches in diameter to which the disk in work was cemented by three spots of pitch.

tained the wet grinding powcase, Carborundum No. 60. This catch box, E, was 16 inches in diameter, and to it was attached an adjustable edge grinder of copper, D, for truing the edges of the lenses of glass disks. The small iron grinder disk, I, (about 4½ inches in diameter) could be given a long or short stroke and set to move over either the center or the diameter of the revolving disk cemented to the face plate, or over chords of it. In this way, by changing the stroke, the roughing out could be made to produce either a concave or a convex form at will, and the radius of curvature could likewise be varied as needed. This small iron tool was used only for roughing out, as it could be given a stroke which would work on one part without unduly wearing down the other parts.

"There was also a third beveling grinder, C, set to bear up under the edges of the lens disks so as to produce a level edge. The figure shows the general arrangement. All three grinders are adjustable. The iron disk can rock on the pin, which is carried by the reciprocating wooden beam B; the grinder under the edge at C can be raised as it cuts away the under edge of the disk; while the edger at D is made to swing toward and from the disk edge, gradually reducing it to complete circular form. The progress toward proper curves was watched either by a spherometer or by templates.

"A very convenient way of making templates of desired radii is to affix a glazier's diamond to a radius bar and cut them from ordinary glass plates, such as window glass or photo plates. When long radii are concerned, this can be done on an open flat



The grinding machine. Redrawn from author's rough sketch

floor. In any case, the cut curved edges of the glass plates are ground together on a flat board until they match. This is a speedy way of securing such templates as are needed. In using such templates, the curved edges can be blackleaded by a pencil and applied to the lens surface, with a slight motion in the length, which will cause a mark to be made on the ground lens surface where the actual meeting contact is.

"After the disks have been roughed out and brought to approximate radii, the work is transferred to the proverbial barrel,

Professor Thomson's observatory, which houses a ten-inch refractor

around which one walks. Care must be taken to support the lens disks evenly and arrange stops (generally of wood) to bear on the edges of the blank to keep it in place. Calipering the edge to secure even thickness all around is a necessity, and the grinding must be governed to do more work on the thicker parts until all is uniform.

"In the case of my 10-inch, the surface R_1—the outer surface of the flint glass disk—was ground to an approximate radius of 74.65 inches, but allowed to become considerably shorter; below 73 inches. This was

The finished refractor

to enable color correction to be better obtained, as estimation showed the likelihood of this provision with the glass used. The rough shaping was by the use of No. 60 Carborundum, changing to No. 120 when near the desired curve.

"One of the plate glass grinders, ground down to present a convex side of about the radius desired for the concave side of the flint lens and the concave side R_2 of the flint lens, was worked on the barrel with this deep convex tool and soon brought to a fit. The curve was adjusted by care, with the aid of the spherometer as a guide, to approach a value of 28.98 inches = R_2. Local grinding at edge or center by small glass grinders enabled such adjustments to be made. Heavy glass tools, except for the rough grinding, were always used. They were generally a little less in diameter than the lens itself. A surface too concave is ground by strokes which avoid the center, while one too convex is worked so as to avoid the edges. In all cases the two fitting surfaces—those respectively of the lens and of the glass disk about eight inches in diameter which is used to produce the surface—are brought to exact fit before measuring. In this way, I have altered long radii of surfaces by small fractions of an inch at a time.

"THE crown glass disk was carefully brought to an even thickness all around, and the surface R_3 was brought to 28.56 inches radius, using on it the deep concave grinder which was used to form it, with No. 120 Carborundum. The last or back convex surface of the crown lens was then shaped to approximately R_4 = 230 inches.

"The next step was the 'smoothing' or

(*Please turn to page 67*)

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

LOCAL BIRD REFUGES (Farmer's Bulletin No. 1644 F, Department of Agriculture) by W. L. McAtee deals with the creation of bird refuges in wood lots, parks, cemeteries, golf courses, et cetera. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

UNDERWATER LIGHTING (Publication D. M. F. 5360) describes a contribution to swimming pool construction. *Technical Press Service, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.—Gratis.*

MATERIAL HANDLING AND POWER TRANSMISSION DATA SHEET No. 1 gives a belt conveyor trajectory chart and accompanying data. *Link-Belt Company, Chicago, Ill.—Gratis.*

NEW LIFE FOR YOUR OLD RADIO SET gives a fund of useful and practical data on the rejuvenation of radio sets. *De Forest Radio Company, Passaic, N. J.—Gratis.*

RADIO MARKETS OF THE WORLD (Trade Promotion Series No. 109, Bureau of Foreign and Domestic Commerce, Department of Commerce) gives full information on the subject. *Superintendent of Docu- (money*

PLATE GLASS MIRRORS (Commercial Standards CS27-30 Bureau of Standards) describes the standards of quality which have been established as a basis of common understanding in the industry. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE SURFACE DECARBURIZATION OF STEEL AT HEAT TREATING TEMPERATURES (Engineering Research Bulletin No. 18, University of Michigan) by W. E. Joining, is an elaborate study of the subject and is accompanied by valuable tables. *Director, Department of Engineering Research, Ann Arbor, Mich.—$1.00.*

THE NATIONAL LUMBER MANUFACTURER'S ASSOCIATION'S ANNUAL REPORT gives information concerning activities in this important industry. *Information Service, National Lumber Manufacturer's Association, 702 Transportation Building, Washington, D. C.—Gratis.*

SAFETY CODE FOR THE USE, CARE AND PROTECTION OF ABRASIVE WHEELS (Bulletin of the United States Bureau of Labor Statistics No. 527—Safety Code Series) gives the revised code for certain sections; in order to keep pace with progress it was found necessary to revise certain sections of the code. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE MAKING OF MIRRORS BY THE DEPOSITION OF METAL ON GLASS (Circular No. 389 of the Bureau of Standards) describes the best methods of making fine mirrors, particularly those for optical apparatus. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

"NI-RESIST" (Bulletin No. 208, The International Nickel Co. Inc.) is a special type of cast-iron alloy which is corrosion and heat resistant. *International Nickel Company, Inc., 67 Wall St., New York.—Gratis.*

BROWN AUTOMATIC CONTROL FOR TEMPERATURE, PRESSURE, FLOW (Catalog No. 8008, Brown Instrument Co.) gives much data of use to executives. *Brown Instrument Co., Philadelphia, Pa.—Free to Industrial Executives.*

PIONEER AND CONSOLIDATED MARINE INSTRUMENTS describes many items of marine equipment. *Pioneer Instrument Co. Inc., 754 Lexington Ave., Brooklyn, N. Y.—Gratis.*

GRAPHIC FACTS ABOUT AVIATION gives statistics in graph form, making a very interesting little brochure. *Carl Byoir & Associates, 10 East 40th St., New York City.—Gratis.*

MEASUREMENT UNITS AND STANDARDS gives data on units and standards and recommends *timex* and *spacex* as names for the Einstein specialization of basic time and space. *American Institute of Weights and Measures, 33 Rector St., New York City.*

EDUCATIONAL DIRECTORY, 1931—PART III (Bulletin 1931, No. 1, Office of Education, Department of the Interior) deals with educational associations, boards and foundations, research directors, and educational periodicals. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

CHESTNUT AS A CORE WOOD (Brochure 4 of the Appalachian Hardwood Club) by George C. Morbeck, describes the use of one of the most valuable woods as a base upon which to glue face veneer. *Appalachian Hardwood Club, Southern Railway Building, Cincinnati, Ohio.*

ROMAN SURVEYING INSTRUMENTS (University of Washington Publications in Language and Literature, Vol. 4, No. 4) by Edward Noble Stone, gives a short description of instruments used by Roman engineers in surveying. The "hodometer" is the precursor of the taximeter. *University of Washington, Seattle, Washington.—75 cents.*

AMERICAN STANDARD SAFETY CODE FOR MECHANICAL REFRIGERATION gives the result of ten years exhaustive research and intensive study, formulated by a joint technical committee representing 28 organizations. *American Standards Association, 29 West 39th St., New York City.—Gratis.*

FIFTY YEARS OF SERVICE TO INDUSTRY describes in detail the work of the *Pittsburgh Testing Laboratory, Pittsburgh, Pa.—Gratis.*

TYPE "K" METALLIZED FILAMENT gives engineering data on tests made on this resistance material. *International Resistance Company, 2006 Chestnut St., Philadelphia, Pa.—Gratis.*

REPRODUCTION ON PULPWOOD LANDS IN THE NORTHEAST (Technical Bulletin No. 223, U. S. Department of Agriculture) by Marinus Westveld, deals with the need for keeping the potential pulpwood lands in this country in a continuously productive state. *Superintendent of Documents, Washington, D. C.—20 cents (money order or coin).*

ENGINE PERFORMANCE AT HIGH COMPRESSION RATIOS (Engineering Research Circular No. 6, University of Michigan) by H. E. Zuck, gives the results of a research in which was studied the effect of compression ratio, mixture ratio, and spark timing, on the tendency of a standard motor fuel and the power developed with such a fuel. *Department of Engineering Research, Ann Arbor, Mich.—50 cents.*

AIRWORTHINESS REQUIREMENTS OF AIR COMMERCE REGULATIONS FOR ENGINES AND PROPELLERS (Aeronautics Bulletin No. 7-G. Aeronautics Branch, U. S. Department of Commerce) gives the official regulations. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

A NEW MATERIAL FOR INTERIORS describes a most interesting material called "Micarta" which has many of the properties of steel, but is quiet, and warm to the touch. It can be made to simulate wood, marble, tapestry, et cetera. *Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.—Gratis.*

OVERPRODUCTION OF RAW MATERIALS (Foreign Policy Association Information Service Vol. VI. No. 24 in two parts, Part I) by Lawrence B. Mann, deals with the overproduction of raw materials, one of the main causes of the downward movement of prices. *Foreign Policy Association, Inc., 18 East 41st St., New York City.—25 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 58*)

stress and strain throughout life, to be heavy eaters of protein and salt and to have occasionally about their bodies minor infections that have not been treated for a long time. The patient with high blood pressure is usually overweight. Doctor Riesman feels that high blood pressure is not only an individual disease but a disease of American life. He says:

"What are the causes of this American disease? They are, I believe, connected with our striving for wealth. We have created false standards, have deprived ourselves of peace and leisure, and have lost the art of living wisely. We have had abundant material success, but have we not paid too dearly for it? It may be difficult to persuade the average American that the price has been too high, for he is still convinced that the civilization that he has created on this continent is the best in the world. There might be nothing wrong with such a sentiment if it did not blind us to some virtues still remaining in the Old World. Winston Churchill, the English statesman, accuses us of thinking that when we left Europe we took with us all the virtues and left all the vices behind. No doubt we took many virtues, but it must be admitted by every candid person that we have evolved a few vices of our own.

"Unlike the European, who, when he has enough for a comfortable living, retires to a life of leisure, the American, when he becomes rich, wants to become richer. He works hard and gambles with his savings. If he chances to be successful, he has in many instances shortened his expectation of life; he has surely done so if his ventures have ended disastrously.

"It might be contended that, notwithstanding our way of living, the span of life has been greatly lengthened—nearly 15 years since 1880. True enough; but when we come to analyze the relevant figures we find that the apparent prolongation of life to the age of 56 is due primarily to the saving of child life and not to the saving of adult life. Statistics clearly show that the span of life after the age of 45 has not been lengthened. It is highly probable that it has been shortened, and that is the price of success."—*M. F.*

New Process for Bonding Metals

FRANCIS R. GLENNER, general manager of the Homogeneous Equipment Co., Brooklyn, New York, has developed a new metallurgical chemical process, for which a patent is being granted, for producing an inseparable homogeneous bonding of metals and alloys which will withstand vacuum, severe vibration, mechanical shocks, and changes of pressures and temperatures close up to the melting point of the metals themselves without buckling, cracking, or peeling. A molecular fusion takes place between the metals throughout the entire surface treated, whereby the metals are inseparably bound together molecularly at every point and act as a single homogeneous unit.

Steel, cast iron, brass, bronze, copper, and other metals can be protected homo-

geneously with lead, tin, and so on, to withstand corrosion or other severe plant operating conditions.

This work is being done on autoclaves, kettles, plates, tanks, tubing, and various types of equipment suitable for the chemical refining and process industries.—*A. E. B.*

U. S. Chemical Industry Shows Balance of Trade

FOR the first time in the recent history of the American chemical industry, American foreign trade struck a balance in 1930, with both exports and imports valued at 172,000,000 dollars. With the exception of the war period, annual imports of chemicals and allied products have exceeded exports by many millions of dollars. Both the inbound and outbound trade has fluctuated during the past 10 years, but during the greater part of this time there has been a gradual approach to the balance.

It is also interesting to note that the exports for 1930 were well above the average for the 10-year period, and even considerably greater than the average for the last five years. The changes in the chemical industry, the *rise to prominence of new* chemical commodities, and the inter-commodity competition are all reflected in the chemical foreign trade statistics. Since 1921, chemical exports have advanced 56 percent, from 110,000,000 dollars to 172,000,000 dollars and imports only 33 percent, from 129,000,000 dollars to 172,000,000 dollars.

The marked fluctuations from year to year evident in the import trade are absent from the export, which for the most part has shown a rather steady upward movement.—*A. E. B.*

Shoe Dye Poisoning

FOR some 20 years medical literature has contained reports of cases of se-...s cyanosis, including some cases of death, following poisoning by shoe dye. Most of the reports concern persons who put on a pair of shoes recently dyed and within a short time suddenly began to turn blue and soon became prostrated. The condition is the result of poisoning by aniline and nitrobenzene, apparently absorbed through the skin, but possibly also to some extent inhaled.

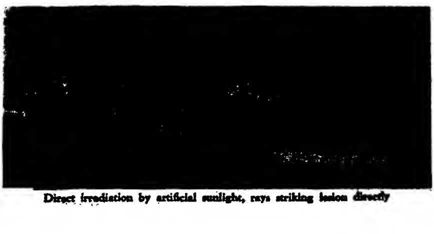
In a case recently reported by Dr. S. J. Levin, the patient concerned was a baby only eight months old. One morning the child suddenly fell over backward in her highchair, turned blue, and in five minutes became unconscious. The physician who examined her noticed a strong, sweetish chemical odor in the room coming not only from the patient but also from the shoes which had just been removed and which were lying on the table. The canvas uppers of the shoes had apparently been painted with black dye, which was still moist. The mother said that the white canvas uppers were soiled so that she had dyed them black and after waiting an hour had put them on the baby. It was found that the blood of the child had changed because of the absorption of the aniline dye so that the blood was not able to carry a sufficient amount of oxygen. The poisoning was of the same type that occurs in illuminating gas poisoning or that following the inhalation of exhaust from a motor car, so far as concerns its effects on the blood.

When the baby was given fresh air and oxygen it recovered fully in 24 hours. Both aniline and nitrobenzene are extremely poisonous substances; therefore, most manufacturers of shoe dyes have begun to use less toxic substances to dissolve the dye. In the case of the dye used on the shoes of this infant, the substance involved was 20 percent orthotoluidine. This substance is much less poisonous than aniline or nitrobenzene, but is apparently sufficiently poisonous to bring about serious disturbances in the blood of an infant.—*M. F.*

Artificial Sunlight for Laryngeal Tuberculosis

FORMERLY tuberculosis of the larynx and of the vocal cords was considered promptly fatal. With the introduction of the use of the ultra-violet rays, it has been possible to promise much to patients with this disorder. Formerly antiseptics were much used in attempting to control the development of the lesions in the throat; now antiseptics have been largely discarded fo this purpose. The chief advantage of the antiseptics is to clean the lesion, to get rid of the dead tissues, and to influence t' surrounding inflammations that are due to germs other than the germ of tuberculosis.

Obviously, it is an extremely difficult matter to apply concentrated artificial sunlight directly to the larynx. Several devices have been developed for this purpose. One device is a type of quartz rod along which ultra-violet rays pass to the larynx from a mercury vapor lamp or from the carbon arc. Another device is a series of mirrors whereby direct sunlight of high intensity is reflected into the larynx. This device is used by patients who have been trained in the use of hand mirrors. A third method



Direct irradiation by artificial sunlight, rays striking lesion directly

Indirect irradiation, the patient looking at his own larynx. Patient sits in front of a perforated mirror and can regulate the rays to fall upon any given lesion

involves the placing of the patient Ir position and the appli steel mirrors In such a form as to throw the light directly into the larynx. There are numerous case records available indicating that this method is of great value in controlling the disease.

A foreign investigator, Dr. Wessely of Vienna, has developed a special apparatus for the purpose and there are other devices prepared by various manufacturers. Dr. Joseph W. Miller reports 74 patients treated by this method—only two of whom failed to improve and 59 of whom showed complete healing.—*M. F.*

Electricity Only Thing Now Cheaper Than in '13

ANALYSIS of the "cost of living" since pre-War days reveals electricity to be the only household item showing a decrease In price, according to a bulletin of the United States Department of Labor.

While prices of all other major classes entering into the "cost of living" budget showed Increases ranging from 37.2 percent for food, to 88.3 percent for house-furnishing goods, and to 108.1 percent for miscellaneous Items, the cost for electric service declined 18.5 percent since 1913, the figures show. Clothing showed an increase of 53 percent and rent an increase of 46.5 percent during the same period.

General living expenses covered in 1913 by one dollar now demand $1.607, whereas electrical energy then bought for one dollar now costs but 81.5 cents. The figure for the relative cost of electricity is based on the average price of 20 kilowatt-hours per month for household use In the 32 major cities in the United States. Relatively, then, the cost of electricity has been cut in half since 1913 If use is restricted to the 20 kilowatt-hour basis. With the much larger consumption of electricity now predominant, the showing is even more favorable.

"Useless" Metal Worth 7000 Dollars a Pound

THE world's first pound of Indium, one of the rarest of metals, has been made in Cleveland, Ohio, by The Grasselli Chemical Company. It is worth 7000 dollars —nearly 10 times the value of platinum. useless"— ercial uses for it, because heretofore there has not been enough of it available for experiment to discover useful applications.

Indium was first discovered in 1863 by two German chemists, Reich and Richter. It was found in a sample of zinc ore by means of the spectroscope. The indigo blue line of its spectrum gave the element its name. It is a white, lustrous metal, very soft and ductile, slightly heavier than zinc, and you can melt it with a match.

Discovery by The Grasselli Chemical Company of a method of producing it electrically puts the metal within the reach of experimental use. The indium is obtained by electrolysis. A current runs through a solution containing indium and causes it to segregate and depo it. Success depends upon very accurate t mperature controls and the use of the p r kinds of electrodes.

Whether this discovery will unlock Nature's storehouse of indium depends on whether its uses prove important enough to justify the price, according to a report to the American Electro-Chemical Society by Dr. L. R. Westbrook.

He believes commercial uses will be developed, and says: "Like many other rare metals which only a few years ago were mere laboratory or scientific curiosities, and which today have a definite field of usefulness, indium undoubtedly has a definite field of application."—*A. E. B.*

Foreign Body Through the Brain

IN the scientific museum at Harvard University, there is a skull through which an iron bar penetrated following an explosion. Now a physician of North Dakota has reported a case of a boy aged 18 who underwent a similar accident and who has apparently fully recovered. He had been placing lighted firecrackers in a pump barrel and holding the handle while they exploded. He put two firecrackers in the pump; the handle then slipped off and the piston shaft was shot through his head. He was brought to the hospital sitting In a wheel chair and apparently in a state of shock but not unconscious.

The piston shaft was cleaned with iodine and withdrawn. The patient was then put to bed and tetanus antitoxin was given to

him. The shaft had entered the skull through the upper angle of the right eye without injuring the eyeball and had passed through the skull, protruding about six inches in the midline. During the course of his treatment, he developed some paralysis of the left arm and hand, but through very careful treatment, including the best of

A pump shaft penetrated the brain, but was removed and patient lived

modern medical science, the patient has almost fully recovered. He has a slight dropping of the right eyelid and some weakness of the left hand and forearm. He has completed another year of high school with success and has no mental impairment. · *M. F.*

Diatoms, Millions of Years Old, Serve Mankind

UNDER the name of diatomite, the tiny skeleton-like remains of microscopic water plants that floated in ancient oceans and lakes are now being made to serve mankind in numerous ways, says the United States Bureau of Mines. These small organisms, which have such interesting posthumous value, are found in all kinds of water, quiet or moving, hot or cold, saline or fresh. Some of them move freely, others attach themselves to various objects, but all absorb mineral salts from the water in which they live. They make skeletons of silica out of this mineral matter in much the same fashion that oysters make she out of lime taken from sea water. Diatoms multiply rapidly, but their life span is short. After they die the organic matter decomposes, and the skeletons sink to the bottom where they gradually build up deposits of diatomite. It is estimated that there may be as many as 50,000,000 individual skeletons in a cubic inch of diatomite, which may be millions of years old.

Common names for diatomite are: diatomaceous earth, tripolite, kieselguhr, and infusorial earth, although strictly speaking the last-named material is not diatomite, says Paul Katmaker, in a report recently published by the Bureau of Mines.

Diatomite is widely distributed over the world. At present the United States has the largest commercial beds and leads in world production, with Algeria second. In the United States the most important commercial deposits are in California, although diatomite is produced in Washington, Oregon, Nevada, and some of the eastern states.

The cane-sugar industry at present is the largest consumer of diatomite, it being used mainly in filtering sugar solutions. Diatomite also is used to a certain extent in the beet sugar industry. Diatomite also may be used for filtering orange juice, lemon juice, and grape juice, vinegar, pectin, citric acid, glucose, lactose, maltose, molasses, syrups, cottonseed oil, corn oil, fish oil, castor oil, lard, used crank-case oil, used transformer oil, petroleum, petroleum-water emulsions, beverages, antitoxins and serums, nitrocellulose, dyestuffs, glycerine, alcoholic extracts, adhesives, various emulsions, sewage, liquid soaps, and chemicals.

Owing to its extreme porosity and fineness of individual air chambers, diatomite in various forms is extensively used as insulating material. For insulating, diatomite may be used as sawed bricks which are cut from the rock in place at the quarry, powder, as bricks which a prepared with some bonding material and then calcined, or as mortars and cements. The bricks are used extensively for lining n which they are usually placed behind a firebrick facing and are backed up by ordinary brick. Thus sandwiched in, they are very efficient in preventing heat losses.

The use of diatomite as a filler for battery boxes has increased rapidly in the last few years. The annual tonnage now so employed is considerable, and this market is one of the most important of the newer outlets which are being developed. Finely ground diatomite is also used as a filler in hard-rubber products, phonograph records, papier mâché, paints and varnishes, oil cloth, linoleum, insecticides, and for other purposes for which a light porous material is required.

Diatomite is used as an absorbent in the manufacture of acetylene gas. It is used also for absorbing chemicals such as bromine, alcohol, and acids, for liquid fuels, liquid manures, and disinfectants. It makes a good packing material for strong acids such as nitric and sulfuric acids because in case of breakage it tends to absorb the spilled acid.

Many metal polishes now on the market use diatomite as a base. The small, tough, freshwater varieties are said to be the best for this purpose. Polishes of this kind may be used for silverware and for scientific and surgical instruments.—*A. E. B.*

PROFESSIONAL METHODS IN AMATEUR ARCHEOLOGY

(Continued from page 40)

in places where excavations or stream cutting are exposing the strata of the rock. In all such localities, the face of the cut should be carefully studied and if human bones or stone utensils are found at considerable depths or associated with extinct animals, your state institution or the Committee on State Archeological Surveys should be notified at once.

Last but not least, every collector should make provision for the care and disposition of his collection in case of his death. The amateur collector has made himself custodian of information of great historical interest and he should guard it against loss or scattering.

The foregoing instructions are far from complete, especially those dealing with excavations. Opening a prehistoric site is a task which should only be taken in an emergency. Use your influence to preserve all mounds and village sites until you can have assistance or advice from a trained archeologist. The Committee on State

Archeological Surveys is anxious to aid you in recovering and preserving the story of man in America, and its Chairman will be glad to receive any inquiries, referring them for answer to the local authorities wherever it seems advisable.

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Madison Bentley, *ex officio*, Chairman of the Division of Anthropology and Psychology.

Fay-Cooper Cole, *ex officio*, 1929-30; Department of Anthropology, University of Chicago, Chicago, Illinois.

THE AMATEUR ASTRONOMER

(*Continued from page* 61)

fine grinding of all four surfaces, without permitting change of radii. Fine washed grades of Carborundum were used for the last 30 minutes during smoothing.

"Next came the polishing with pitch and rouge. Surface R_3 was first worked, then R_2. At this stage, R_1 was given a partial polish. I term this 'glossing.' Though the polish is not more than partial, still it is sufficient to enable optical tests to be made and can be produced in a few minutes.

"The same 'glossing' was given to R_4.

"Tests for color correction and spherical aberration were now made, using an artificial star in the usual way. There was found overcorrection for color and considerable negative spherical aberration. The surface of flint lens R_1 was then reground and given 71.8 inches radius, while R_4 was worked locally for spherical correction, as most of the fault seemed to be in that surface. Tested again, the color correcti was found to be satisfactory—pale lilac a soft apple green overhanging. Completi of polish was now given to R_1 flint ou surface, leaving R_4 (back of crown) s partly polished. After quite a series of tests involving repeated trials and small corrections, surface R_4 received its final polish. Result: ring systems inside and outside of focus good, and definition excellent. Tests of focal length gave 139.5 inches; aperture full ten inches, a ratio of aperture to focus 1:14, very n---·

"The polishers were iron disks ı inches in diameter, faced with the ...... pitch squares and worked with levigated rouge and water. The final measurements of radii gave: $R_1 = 71.8''$; $R_2 = 28.93''$; $R_3 = 28.5''$; $R_4 = 229.04''$.

"The lens was placed in its cell and mounted on a Warner and Swasey steel tube. The equatorial mounting was partly made from my drawings, and many of the patterns for the castings, including the heavy, hollow pillar, I made myself. In the pillar is the drive, which consi... ... ... fan motor (A. C.) controlled by a sensit centrifugal governor which I construc for the purpose and which I found v satisfactory. Through a relay it cuts motor in and out at about one-half secc intervals, and can be regulated ......

"For the purposes of testing, I had made a 12-inch plane and used it with an artificial star in all the later stages of adjusting and figuring the 10-inch objective. To avoid dust and grit while the delicate polishing was carried on, the work proceeded in a closed room (no open windows) and in the hottest weather, a great advantage of which is that the temperature of the skin is very near that of the glass, and danger of distortion by irregular heating is diminished. Further, the extreme humidity, though very uncomfortable, permits the grinding and polishing to proceed without rapid drying of the water out of the powder being used.

"Tests on the stars showed excellent definition, and the characteristic interference rings inside and outside focus were developed symmetrically and were perfectly circular when a star was observed. The performance of the lens was as good as could be expected. It resolves double stars down to 0.5 second separation, and this is about the theoretical limit for 10-inch aperture. When the members of a pair of s are 0.3 second apart, it will shov or when the two are of different magnitude, an egg-shaped image. Small stars at 0.6 second apart are seen very clearly separated. The outstanding secondary spectrum is at a minimum for the glasses used, and the lens shows stars of small magnitude, with a single interference ring around the image. On steady nights during favorable oppositions of the planet Mars and at times of best seeing, the so-called *canali* of Mars are plainly visible, with the other markings of that interesting object. The divisions in the rings of Saturn are distinctly observed, and at times a graininess of the inner ring, like the streaks from a paint brush, is seen.

"I have not dwelt on the mechanical details of the mounting, which is in essence the usual equatorial, nor have I dwelt on accessories, such as spectroscopes constructed by me in my workshop, helioscopes and the like—deeming the central problem and the one demanding most skill to be the objective lens itself."

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Patent Royalty Held Non-taxable by State

THE corporate income tax levied under authority of the North Carolina statute may not include income derived from royalties for the use of patents, the State Supreme Court held in a case entitled *State versus* Chemical Construction Company, reported in *The United States Daily.*

The Supreme Court of the United States has so held, the court declared, citing Long *versus* Rockwood, 277 U. S. 145. "In that case," the opinion said, "it was held that a State cannot tax royalties for the use of a patent issued by the Commissioner of Patents of the United States under the authority of an act of Congress. The Congress of the United States is expressly empowered 'to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.'"

Quoting previous cases on the subject, the opinion said: "A patent right itself is not taxable by a State. Letters patent issued by the United States give to the patentee a right of monopoly in the invention, and with this right the State can not interfere. The patent is the instrumentality by which the United States confers upon the patentee, his heirs and assigns the right to the exclusive use of his invention or discovery, for a limited time. As a State can not tax the patent, it can not tax the royalties received from its use. What the State can not do directly, it can not accomplish in an indirect way.

"We do not think that the decision in Long *versus* Rockwood is affected as an authority on the question presented in the instant case, as suggested by the Attorney General in his brief filed in this court as counsel for the relator, by the decision in Educational Films Corporation *versus* Ward, decided on Jan. 12, 1931, and reported in 75 L. Ed. at page 233." The North Carolina court said: "In that case a tax levied under a statute of the State of New York on complainant for the privilege of exercising its corporate franchise in said State was upheld, although the amount of the tax was determined by the income of the complainant derived from royalties for the use of patents owned by complainant. The decision of the question there presented was not controlled by the decision in Long *versus* Rockwood. The distinction is made in the opinion of the court delivered by Mr. Justice Stone."

"Ethyl" Mark Protected

FIRST Assistant Commissioner Kinnan has held that the Lyons Storage Battery Company, of Belleville, New Jersey, is not entitled to register the term "Ethyl" as a trademark for storage batteries, in view of the prior adoption, use and registration by Ethyl Gasoline Corporation, of New York, New York, of the same term as a trademark for motor fuel oil.

The grounds of the decision are that the goods of the respective parties are such that, if the same mark were used on both, confusion would be likely and that the mark is a distinctive portion of the opposer's corporate name.

With reference to the goods, after noting that automobiles use gasoline as the motor fuel and storage batteries to furnish the initial start to the engine and to furnish the electric spark to ignite the charge and both are used on the same vehicles, the First Assistant Commissioner said:

"* * * there would appear to be a reasonable probability that one familiar with the trademark and goods of the opposer and seeing the same mark upon the battery would think the latter had its origin with the opposer company. In view of former holdings it is believed proper to hold that confusion of origin being likely, the goods of the respective parties belong to the same class."

With reference to the opposer's corporate name, he said:

"* * * there is no showing that this portion of opposer's name has been used by others in connection with goods of this class prior to the formation of the opposer corporation. It would seem in consequence that the applicant should not have adopted as its mark so distinctive a portion of the opposer's corporate name."

With respect to the argument of applicant that the term has a meaning in the language in connection with such classes of goods as alcohols and hydrocarbons and therefore the right which the opposer might otherwise have is restricted, he said:

"There is no contention, however, that the word is descriptive of the goods of either of the parties. It is believed the applicant in selecting its mark should not have chosen that which the opposer has been from a date long prior using upon its goods and in its corporate name."

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

New Alloys Extend Field of Zinc's Usefulness

METALLIC zinc has extended its services into new fields as a result of much thoughtful and painstaking research work. This has been accomplished through the discovery of new zinc base alloys having properties quite different than those of the commercially pure metal, says Robert M. Curts in a recent issue of *Chemical Markets.* The most important development which has taken place in the effort to establish uses for zinc is the discovery of greatly improved die-casting alloys. This applies primarily to "pressure" die cast- which are made by forcing molte [illegible] of the size and shape necessary to produce e desired object.

For a time an alloy composed of 4 to 5 percent aluminum, with 3 percent copper, and 92 to 93 percent zinc seemed to serve satisfactorily, but it was soon noted that after several years in service the castings made of it tended to become brittle and often underwent changes in dimensions which interfered with the proper functioning of the mechanisms of which they formed a part.

This prompted a rather detailed study of the copper-aluminum-zinc alloys which has led to a better understanding of the causes of such "aging" phenomena. It was found that growth and loss of physical properties could be attributed to two causes—intercrystalline oxidation and internal phase changes, both of which are effected by atmospheric conditions.

Out of all this work the "4-3-.1" alloy was evolved—United States Patent 1596-761. This alloy is composed of 4 percent aluminum, 3 percent copper, 0.1 percent magnesium, and 92.9 percent high grade zinc. With a tensile strength of 46,000 to 48,000 pounds per square inch, an initial impact strength of well over 100 foot pounds per square inch, freedom from growth through intercrystalline oxidation, and a decided retardation of internal phase changes, this alloy shows a vast improvement over the old 6 percent tin alloy and the 4 percent aluminum, 3 percent copper alloy.

It has been recognized as a satisfactory engineering material in many fields where, heretofore, zinc alloys were not considered acceptable. It is employed in the manufacture of automobile fuel pumps, carburetors, body hardware, radiator caps, lamp housings and supports, steering wheel parts, and so forth. It is used in the manufacture of parts for washing machines, check writers, postage meters, vending machines, printing presses, cash registers, weighing machines, fare registers, and pencil sharpeners.—*A. E. B.*

"No-Nox" Not a Trademark

IT was recently held by First Assistant Commissioner Kinnan that the Gulf Refining Company, of Pittsburgh, Pennsylvania, is not entitled to register, under the Act of 1905, the notation "No-Nox" as a trademark for motor fuels.

The ground of the decision is that the notation is merely descriptive of a character or quality of the goods.

In his decision, after stating that it is a matter of common knowledge that under some conditions a motor will "knock" and

that such "knocking" is generally attributed to pre-ignition of the charge, and that some grades of gasoline were until recently regarded as producing this "knocking" to a greater extent than others, and noting applicant's argument that the notation was intended to convey the suggestion that applicant's goods were non-poisonous or non-noxious, and referring to a number of decisions in which marks including the word "No" followed by a statement of function were held descriptive, the First Assistant Commissioner said:

"In the light of these adjudicated cases, the applicant's notation must be held merely descriptive of the character or quality of its goods if the purchasing public would obtain from it nothing more than the information that the applicant's gasoline would, when used in a motor, produce no knocks. It seems clear enough this notation would have only this effect upon the minds of users of the applicant's gasoline. 'Nox' is an obvious misspelling of 'knocks' and is, in fact, given in the dictionary as indicating the proper pronunciation of the latter. The notation appears to be but an equivalent in its meaning of anti-knocking or non-knocking when applied to gasoline."

"Perpetual Motion" Applicant Must Show Model

AN outline of Patent Office procedure, officially issued more than 100 years ago, stating that efforts to establish perpetual motion "ought never to be attempted until the sun rises in the West," established policies which continue to be followed in handling patent applications of the "perpetual motion" class.

The old rules, promulgated in 1811, specified that every application for a "perpetual motion" patent be accompanied by an "operative model" and the same requirement remains in force at the Patent Office, many years after the practice of asking that models be submitted with applications for other types of patents has been discarded.

The following additional information was recently made available by officials of the Patent Office:

Requests that the Patent Office issue patents on devices stated by applicants to embrace principles of so-called "perpetual motion" continue to be received periodically.

The section of the rules of procedure promulgated in 1811 relating to "perpetual motion" follows in full text:

"As it can be mathematically demonstrated that no human invention can produce a machine capable of undiminished power, or power regenerating itself, and forming what is called perpetual motion, an operative model will be demanded for every such attempt, before a patent can be granted; otherwise no proof can be given of its being what its name designates, and for which a patent is demanded.

"It is hoped that this will prevent many ingenious, but unlearned, men from attempting what the scientific know to be impossible. Some set out by searching, through levers and large wheels, to increase power, forgetting that this is to diminish velocity—then they multiply and diminish the power to give velocity; this brings them to the point whence they set out. Thus it is considered an axiom in mechanics, that to increase power is to diminish velocity, and vice versa. They must also consider that man, in all his operations, works against gravity and friction.

"A perpetual motion is therefore only considered as a perpetual motion; and ought never to be attempted till the sun rises in the West."

The form letter transmitted by the Patent Office to each person seeking patents of the "perpetual motion" class follows in full text:

"Replying to your recent letter, you are advised that the Patent Office understands the term 'perpetual motion' to mean a mechanical motion creating energy; that is, a machine doing work and operating without the aid of any power other than that which is generated by the machine itself, and which, when once started, will operate for an indefinite time.

"The views of the office are in accord with those of scientists who have investigated the subject, and are to the effect that mechanical perpetual motion is a physical impossibility. These views can be rebutted only by the exhibition of a working model. Many persons have filed applications for patent on perpetual motion, but such applications have been rejected as inoperative and opposed to well known physical laws, and in no instance has the requirement of the Patent Office for a working model ever been complied with.

"In view of these facts the office will not now permit such an application to be filed without a model, and this practice has been adopted in order to save applicants the loss of the fees paid with their applications. After an application for patent has been considered by the examiner the filing fee cannot be returned."

"Diamond Test" Refused Registration

ASSISTANT COMMISSIONER MOORE recently held that Nestor Johnson Manufacturing Company, of Chicago, Illinois, is not entitled to register a mark consisting of the words "Diamond Test," somewhat peculiarly displayed, as a trademark for ice skates in view of the prior adoption and use by the Shapleigh Hardware Company, of St. Louis, Missouri, of the words "Diamond Edge" as a trademark for the same goods.

The ground of the decision is that the marks are confusingly similar and the opposer was the first to adopt and use its mark.

In his decision, after referring to the record with reference to certain prior registrations attained by the opposer and the testimony to establish use, and holding that such use was prior to any use by the applicant, the Assistant Commissioner, with respect to the mark under consideration, said:

"Respecting the confusing similarity of the marks, it is believed that the word 'Diamond,' which is common to both marks, is the controlling characteristic, the characteristic which would be most likely to make a lasting impression upon the mind of the purchasing public, and that the two marks are otherwise confusingly similar as to the manner in which the words are displayed."

With reference to the contention based upon the use by others of the word "Diamond" the Assistant Commissioner said:

"With reference to the trademarks owned by others comprising the word 'Diamond,' noted by the applicant, it may be stated that such may not ordinarily be considered in an opposition proceeding (citing decisions). It may be proper to cite such registrations in order to show that the mark under consideration is public property, but no such condition exists in the instant case. While it is true that the word 'Diamond' is a common dictionary word, yet no reason is apparent why it may not be properly used arbitrarily as a trademark. Obviously it is not descriptive of the goods. The most that can be said is that it suggests the quality of hardness when associated with the goods."

"Tucork" Mark Allowed

THE Armstrong Cork and Insulation Company, of Pittsburgh, Pennsylvania, has shown no grounds upon which Tuco Products Corporation, of New York, New York, should be refused registration of the term "Tucork" as a trademark for composition flooring and insulating products, such as cold storage and refrigerating insulation, according to a decision in a case between these two companies, handed down by Assistant Commissioner Moore.

In his decision, after referring to the statute, which requires that marks shall be registered, except under certain conditions, and stating that it was not clear in what respect the opposer had brought himself within the statute, and noting that the opposer states that it associates the word "cork" and the term "cork board" with its goods, the Assistant Commissioner said:

"* * * there is nothing of record showing that the opposer has the right to the exclusive use of cork, with its well known properties and characteristics, for insulating purposes, nor the right to the exclusive use of the word 'cork' as the name of the product."

He then stated that the opposer's main contention was that the mark was descriptive of the opposer's goods and false and misleading when applied to applicant's goods, which contention was based on the ground that the mark sought to be registered means "true cork" whereas the applicant's goods contains practically no cork. He then said:

"The applicant explains that its mark was not intended to mean, and does not in fact mean, 'true cork'; also that said mark was formed from the first part of its corporate name TUCO, with the letters RK added thereto, and that the word cork was included in its trademark as suggestive that its product possesses properties or characteristics similar to cork."

"I am of the opinion that the applicant's mark would not be interpreted by the members of the public as meaning 'true cork' but as an arbitrary and technical trademark."

"As to opposer's contention that the applicant has been guilty of deception and fraud on the public by using the mark 'Tucork' on its goods, it may be stated that this is a question between the applicant and this Office and does not affect the opposer any more than any other member of the public. In fact, the opposer should be the least interested as it does not purchase or use the applicant's goods."

Books SELECTED BY THE EDITORS

MATHEMATICS FOR SELF-STUDY
By J. E. Thompson, Dept. of Math., Pratt Institute

FREQUENTLY we desire to solve some problem that arises in our work and we find considerable rust has formed since we last attained a similar solution. Here in four handy volumes are to be found arithmetic, algebra, calculus, and trigonometry for the practical man, presented so that the mathematics are made interesting and as easy as is possible by simplifying the conventional methods; a wide variety of practical problems are clearly worked out. Though intended primarily for self-study, the wide applications given make a splendid set to have ready for reference.—$7.80 postpaid or each volume $2.15 postpaid.

THIS MECHANICAL WORLD
By Morton Mott-Smith

A DISCUSSION of the physical principles upon which our many mechanical wonders are based, with clear and fundamental interpretations of classical physics, devoid of mathematics and formulas. It humanizes and frees the subject from the conventional textbook aspect.—$2.15 postpaid.

CONCRETE DESIGN AND CONSTRUCTION
By Webb and Gibson

ONE of the most useful materials of construction from the simpler monolithic to the more complicated reinforced types, the subject is detailed in plain and concise manner, suitable for both engineers and students. The composition and treatment of the materials, the steel for reinforcing, fire-proofing qualities, and the general theory of flexure as well as tables, diagrams and designs, with flat-slab construction, simple and compound footings, etc., are some of the features covered. 388 pages. $5\frac{1}{2} \times 8\frac{1}{2}''$—$2.70 postpaid.

STEEL CONSTRUCTION
By Burt & Ritow

DESIGNERS and students will find here the necessary data, easily accessible, for the complete design of structural steel work for business buildings and enough illustrations to guide in the solution of the problems usually encountered in practice. A complete set of drawings and detailed explanations in connection with the design of a 16-story hotel, forms a unique feature of this complete treatise.—$2.70 postpaid.

EXAMPLES IN BATTERY ENGINEERING
By Prof. F. E. Austin

INTENDED for those who wish to become engineering students as well as for the battery expert, this book explains in detail in a unique way many practical phases of battery engineering. It is the kind of information that will save operators much time and money in ordinary running, upkeep, and repairs. --$1.40 postpaid.

BIOLOGY IN HUMAN AFFAIRS
Edited by E. M. East, Prof. Genetics, Harvard

THIS book contains discussions by 12 prominent men of science, on the subjects which radiate from biology; namely, sociology, psychology, heredity, medicine, public health, physiology, zoology, and dietetics. It is not a textbook or a treatise but a series of mature, thoughtful essays such as one would expect to find in serious monthly reviews. Readers of the kind who can assimilate such reviews will also assimilate this, while on the other extreme the "adult infants" of whom Professor East speaks in his part of the book (the best part, to our way of thinking) will wonder what it is all about and clamor for lighter pap. 383 text pages, unillustrated. good format.--$3.65 postpaid. —*A. G. I.*

HANDBOOK OF CHEMICAL MICROSCOPY
By E. M. Chamot, Prof. Chem. Microscopy, and C. W. Mason, Asst. Prof. Chem. Microscopy, Cornell

CHEMICAL microscopy enables the worker in this peculiar field of scientific investigation to identify an immense number of substances, mainly chemical, under the microscope. It is a special kind of qualitative analysis which has been developed to an astonishing extent largely by the authors of this work. These volumes are thoroughly practical, being a working manual for the actual investigator. Volume I covers the microscope itself in theory and practice, including ultra-microscopy and photomicrography; also chemical crystallography, particle size determination, and odd methods. Volume II concerns the actual microscopical analysis. The two books contain 853 text pages and many illustrations. The reader should have access to a compound microscope and have some knowledge of chemistry and physics but the volumes are not abstruse.—$4.70 each postpaid. —*A. G. I.*

TWO THOUSAND YEARS OF SCIENCE
By R. J. Harvey-Gibson, Prof. Univ. Liverpool

ONE way to understand science is to read about the modern sciences one by one, but a still better way is to study the development of each one from early times to the present. Here is a book which combines both ways. It gives a grand synthesis of all the sciences as they have developed, right up to the year 1930. Only a person who has approached science in this way can know how much deeper a significance the great discoveries thereby take on. Although the various sciences are treated historically, 244 of the 465 text pages of this book also treat fully of "The Science of Today." The language is understandable, not abstruse, yet is not "tabloid" language by any means. In short, the book is not a "sentence to hard labor" but good reading—about the kind that would be ideal for normal publication in the SCIENTIFIC AMERICAN. —$2.65 postpaid.—*A. G. I.*

EXPLORATORY SCIENCE
By Ben J. Rohan, Supt. Schools, Appleton, Wis.

EXPLORATORY Science, A Means of Life Guidance, is a challenging, inspiring and timely presentation of the potentialities of exploratory studies in science as an influence in developing a sound life philosophy; promoting self discovery; inducing comparisons of life activities; widening social visions; arousing life interests; and encouraging analytical and constructive thinking. The book is intended primarily for science teachers and analytical readers who enjoy delving into cause and effect. —$1.65 postpaid—*A. G. I.*

THE DIVINING ROD
By Sir William Barrett and Th. Besterman

AS a fertile source of red hot arguments the old question of water witching—the use of the hazel bough for locating underground water—is perennial. While the proponents of this art of "dowsing" have convinced extremely few scientific men of its possible authenticity, science has not wholly disposed of dowsing. This question is one which cannot even be dealt with except empirically because, if there is any scientfic principle behind it at all, that principle is not at present understood and therefore there is today no adequate suitable "tool" for making any truly promising scientific investigation of it. However, so many inquiries concerning this art have been received that the best, most detailed book available (so far as we know) is placed on review despite the fact that it is not a brand new work (published in England 1926). While we do not regard this treatise as a cold, objective, judicial embodiment of the true scientific method, since it leans toward the water witching side, it did prove to be very good reading. It is offered with these caveats.—$5.75 postpaid.—*A. G. I.*

PATENT LAW
By Fred. H. Rhodes, Prof. Industrial Chem., Cornell.

PLANNED to give men in technical and administrative work a broad, general understanding of the law of patents, the requirements for patentable invention and the rights conferred by a United States patent. Technical legal terms are avoided as far as possible but the various points brought out are illustrated and substantiated by citations from court decisions in patent cases. A good follow-up for Wright's "Inventions and Patents" as it presents the broader aspects which are liable to ensue from the further development of situations which subsequently arise. 207 pages which include various forms, an index of citations and a subject index. A well rounded, comprehensihle treatment.—$2.65 postpaid.

DANGEROUS DRUGS—THE WORLD FIGHT AGAINST ILLICIT TRAFFIC IN NARCOTICS
By Arthur Woods

THE author will be remembered as being one of the best police commissioners New York City ever had. He was formerly Assessor to the Advisory Committee on Traffic In Opium and Other Dangerous Drugs of the League of Nations. Every few days we read of narcotic seizures, usually of large proportions. Mr. Woods says: "The fact is that for every ounce of these commodities that serves a proper purpose, there are at least ten ounces that finally reach an enslaved addict." This is the crux of the situation. The illicit traffic in dangerous drugs must be suppressed and Mr. Woods sounds a note of warning and makes excellent suggestions for combating the evil. The concentrated nature of the drugs makes smuggling easy. The solution seems to be supervision of manufacture for medical and scientific needs only and drastic control of transfer of drugs from one country to another so that they will not wander from the legitimate path.—$2.10 postpaid.—*A. A. H.*

SMALL BOAT BUILDING
By H. W. Patterson

WE frequently are asked to name a book on this subject as well as on the care and repair of hulls already built. This little book will be found to cover adequately these subjects in a practical and understandable way. The author is well known for his knowledge along these lines and his explanations carry the weight of appreciative knowledge and enthusiasm covering just the points a small boat owner wants to know.—$1.15 postpaid.

LEIF ERIKSSON—DISCOVERER OF AMERICA A. D. 1003
By Edward F. Gray

WITH all the bibliography available and after 25 years' residence in Norway, with six years spent covering the Cape Cod, Martha's Vineyard and No Man's Land territory, the author conceives that he has settled the question of the earliest landfalls and definitely hooks up sagas, traditions, and monuments until it all makes one clear narrative. Just how historically important these conclusions are must be left to the reader. In any case the well executed format and fluent style of narration make most fascinating reading. One should not miss this cultural entertainment.—$7.70 postpaid.

LAPLAND
By Johan Turi

WRITTEN by a man who did not learn to read or write until he was grown, a Fell-Lapp who has lived a nomadic life, traveling through the wilds with his reindeer. He tells of queer medical practices, religions, and folklore. It is as if a legendary figure in a primitive saga materialized and talked. Truly a nomad's biography, naïve as a fairy tale and with a peculiar mixture of Christianity and Norselandic legend. Original sketches remind one vividly of our own Indian character writing.—$2.65 postpaid.

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FROM "Yankee Doodle" to the latest war songs, our significant national ballads are delineated both as to authorship, cause of conception, and the underlying facts of production. It makes an inspiring story of the times and conditions at periods of most vital import in our nation's history, one rich in interest and potentiality, how deep and abiding no one can surely estimate. —$2.65 postpaid.

LUMBER AND ITS USES
By Royal S. Kellogg

A FOURTH edition revised and enlarged presents a practical treatise describing in non-technical language the properties and uses of the principal commercial species of wood which are manufactured into lumber. A manual for everyone who uses, buys, sells or specifies lumber, makes wood products or builds of wood. The structure and physical properties of wood, lumber and log measurements, lumber grades and sizes, structural timbers, shipping weights, seasoning, preservation, paints and finishes, fire-resistance, forest products, and so on through the entire field, are all fully covered. 378 pages, flexible binding.—$4.20 postpaid.

CROSS-ROADS OF THE JAVA SEA
By Hendrik de Leeuw

A TRAVEL narrative of a more seasoned and very human type, Cross-Roads of the Java Sea has tremendous value as an ethnological and sociological study of the islands of Java, Sumatra, Borneo, Celebes, and Bali. It is the first of its kind since 1868. The industry and trade of the islands, and the habits, customs, religions, superstitions—in fact, everything worth knowing about their strange peoples—are detailed with such deft speed and understanding that one marvels at the Dutch-American author's amazing facility with English and his ability to gather and collate material. Seldom have we been so fascinated with a book of non-fiction as we have with this one. It is well illustrated with photographs and drawings, and is supplemented by a bibliography of several hundred titles.—$3.65 postpaid.—*F. D. McH.*

SCIENTIFIC AMERICAN ADVERTISERS

JULY · 1931

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6 North Michigan Ave., Chicago, Ill.
BLANCHARD-NICHOLS-COLEMAN
Western Advertising Representative: Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

ORSON D. MUNN, President
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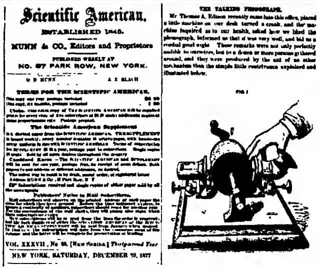
A GREAT DAY FOR INDUSTRY

IT WAS WHEN



Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

The Scientific American Supplement

VOL. XXXVII., No. [New Series.] Thirty-second Year

NEW YORK, SATURDAY, DECEMBER 22, 1877

THE TALKING PHONOGRAPH.

Mr Thomas A. Edison recently came into this office, placed a little machine on our desk, turned a crank, and the machine inquired as to our health, asked how we liked the phonograph, informed us that it was very well, and bid us a cordial good night. These remarks were not only perfectly audible to ourselves, but to a dozen or more persons gathered around, and they were produced by the aid of no other mechanism than the simple little contrivance explained and illustrated below.

EDISON gave the first public demonstration of his phonograph in the office of SCIENTIFIC AMERICAN, Dec. 1877

1845 . . . 1931

WITHOUT a single exception every issue of SCIENTIFIC AMERICAN has brought something of importance to the Industrial Executive, something which was authenticated before being presented. During these 86 years a confidence has been established among our readers which extends to the advertising as well.

Truly has it been said that "of all the assets of advertising" there is nothing "greater than the consumer's inherent desire to want to believe advertising."

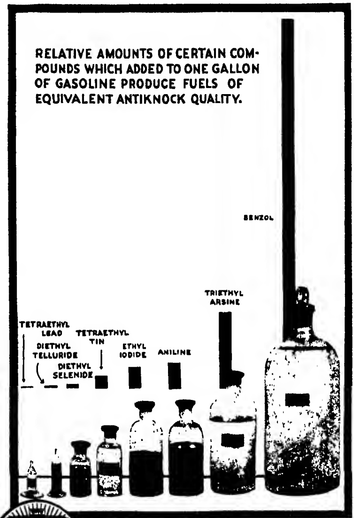
Industrial Executives may well consider the consumer confidence built on such firm foundation.

L. S. Treadwell.

Vice-President • Advertising Director

*E*thyl is the *most practical* anti-knock ingredient known

Compare!

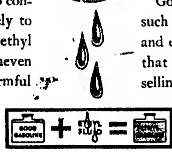


IT took seven years of testing and experimenting to produce Ethyl fluid. During that time, 33,000 chemical compounds were studied.

All the compounds shown in this picture have anti-knock qualities. None of them is nearly so practical as tetraethyl lead, which is the active ingredient in Ethyl fluid. Some are required in such large quantities that more than the total available world supply would be needed to treat all the gasoline requiring anti-knock. Others do not vaporize easily and completely.

Even tetraethyl lead cannot be used alone. It is mixed with other chemicals which combine with it at the time of combustion to form a gas that passes out of the cylinders.

The red dye which is in all Ethyl fluid has nothing whatever to do with its power to control combustion. The dye is added solely to give an identifying color. It is the tetraethyl lead in Ethyl fluid that prevents the uneven explosions that cause power-waste, harmful "knock" and overheating. It *controls combustion* so that power is delivered to the pistons with a smoothly increasing pressure that brings out the maximum performance of any car.



Good gasoline *plus* Ethyl fluid makes such an improvement in car performance and effects such a saving in operating cost that Ethyl Gasoline has become the biggest selling brand of motor fuel in the country.

Ethyl Gasoline Corporation, Chrysler Building, New York City.

ETHYL GASOLINE

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SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

ACROSS THE EDITOR'S DESK

FOR several weeks prior to the general newspaper announcement of a new endurance record set by a Bellanca plane equipped with a Packard Diesel engine, we had been in touch with the engine manufacturers. Although we knew of the preparations being made for the flight, it was necessary to forego publication of anything on the subject until a new record had actually been established. Needless to say, we watched with great interest the first two flights which failed to reach the objective, and were enthusiastic over the results of the third and successful attempt. A wire of congratulations elicited from Mr. Macauley of the Packard company a letter which set forth so many illuminating data on the flights that we publish it in its entirety in the SCIENTIFIC AMERICAN Digest in this issue.

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A scientific pastime that holds in store for those who heed its call a glimpse of a new world unknown to the average person, in part of which immortality appears to hold sway, involves the use of only a microscope and a few drops of water from a stagnant pond. When beginning the study of biology, the writer placed a few wisps of hay in a bowl of water and let nature take its course for a few days. Then a drop of the water was placed on a microscope slide and the 'scope focused on it. An animated figure eight was in the field of vision, and as we watched, it suddenly split into two parts, each of which went its own way. We had been a witness to the reproduction of a *Paramoecium*, an inhabitant of the microscopic world, which reproduces by division. There were other things to be seen as well, and we spent many fascinating hours over the 'scope before other work claimed our attention. The other day we were taken back, in memory, to those earlier days, when we read and accepted an article entitled "Into a Hidden World," in which the author deals in a light yet authoritative manner with "pond life." After you read this article in a coming number, you will probably start to think seriously of getting yourself a microscope and a few drops of water.

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Some of our most illustrious men were products of the little red school-house. Likewise, some of our most famed airplane pilots are products of the not yet abolished, haphazard method of instruction by a pilot who, himself, has had but scant training. But since safety in the air depends to a great extent on the ability of the man at the stick, it is not good logic to believe that poor training will suffice. But what is a good school? And what is a good curriculum of flight training? The Department of Commerce has answered these questions by regulations governing the operation of air schools, and Mr. G. W. Orr, President of Roosevelt Aviation School, discusses in our September issue flight training under these rules.

•

Science, especially that basic science, physics, has now come to an impasse; it seems to be stumped, at least temporarily. It can't get farther along on the road toward discovery of the true, ultimate nature of the final basic concepts of the science —such as time and space and energy and matter— because of something new, the principle of "indeterminacy" and the work of the English scientist Dirac. It begins to look as though there never will be a way to penetrate to the real bottom of things and thus we are left in the position of the old lady who lost her glasses and could see to find them only if she had them! Has science then reached a stalemate, temporary or permanent? Who knows? This and cognate thoughts are discussed by the philosophical physicist, Dr. Paul R. Heyl, of the Bureau of Standards, in our September issue.

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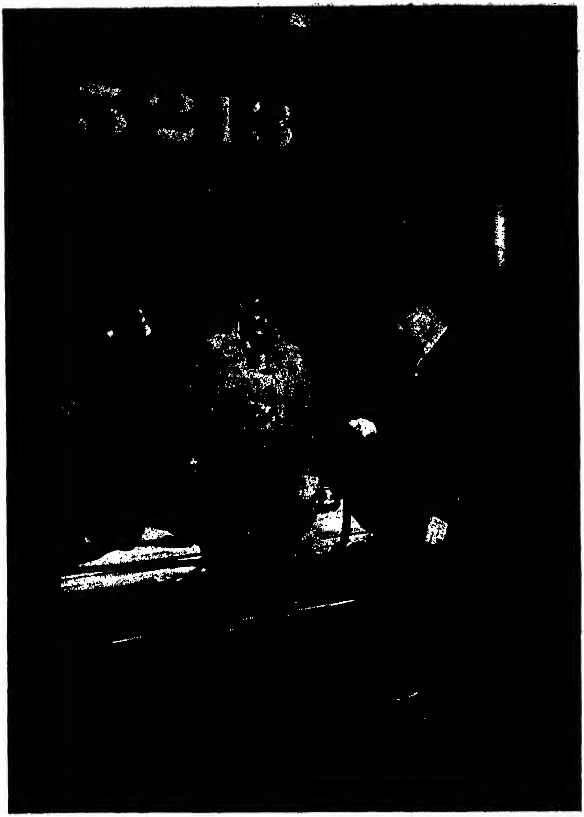
Among other articles soon to appear is one of vital importance to the sportsman and to everyone who is interested in the preservation of our natural scenery and our native birds and animals. Entitled "Wild Life in a Fire," it draws a sad yet true picture of the ravages wrought by unchecked fires as they sear their way through forests, killing everything in their paths and leaving wide swaths of ruined woodland dotted with the bodies of the wild things that have fallen victim to the flames. Forest fires, in the majority of cases, are not unavoidable. They can and must be checked, and it is only by the co-operation of all who enter the woods that we can hope to see the end of this wasteful destruction of one of the most valuable of our natural heritages.

Orson D. Munn

DR. WILLIS R. WHITNEY

MEN of science are often criticized for taking so little time off—or none at all—to be really human. Dr. Whitney, Vice President and Director of the Research Laboratory of General Electric Company, is a notable exception, as the photograph bears witness. The latch string hangs outside the door of his office at Schenectady, and he is always available to even the least important of his subordinates. As an administrator, he stands high in the estimation of his company; and as a scientist, he has won a string of degrees, holds a permanent place on consulting boards, advisory committees, and boards of directors of several scientific institutions, and has been awarded a number of medals for noteworthy research, the latest of which is the Franklin Medal which was presented by the Franklin Institute.

With him in the photograph is a little dog which was restored to health by radio-created artificial fever and other experiments. When brought to the laboratory, this dog was suffering from an "incurable" mange. In a recent address, Dr. Whitney told how this "radio fever" is being studied by several competent groups of American doctors and research men for its possible value to the medical profession, and suggested that perhaps the time will come when it may be used to supply internal heat to human beings so that the artificial heating of houses will be unnecessary.



CORRECT TIME IS ESSENTIAL TO SAFE RAILROADING

In no industry or enterprise is time so important a factor as in railroading. There must be as perfect a meeting of time in watches as of minds. The dispatcher, the conductor, and the engineer must have unvarying time; watches must be of known make and they must constantly be tested and adjusted. A comparison is made at the beginning of every long run. Astronomical time filters down through the dispatcher's office to the watches of the crew. To insure efficient railroading all the men's watches must run as uniformly as can be made possible by fine craftsmanship and by inspection.

The "Columbian" drawn by the "President Fillmore" has just received the signal to leave the Washington terminal

TIME AND THE RAILROAD DISPATCHER

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice-President, Baltimore and Ohio Railro

TIME, on the railroad, is a benevolent master. The hands of the clock daily control the movements of thousands of trains. Time tables are consulted by millions of people scattered in cities, towns, and hamlets everywhere. The commodities of the nation are moved and delivered on a time basis. From the last stroke of twelve of one year to the last stroke of twelve the next, time is master—and "waits for no man."

It is, perhaps, not too much to say that the whole complex structure of railroad organization would collapse without the aid of the vital coordinating force symbolized in the clock. Suppose that by some meteorological freak, all our watches and clocks should become oddly magnetized and run in crazy fashion. This phenomenon would probably not seriously disrupt the normal processes of most of the industries, but the operation of the railroads would turn into great confusion. Trains would run, for they are guided and guarded these days by elaborate and ingenious signal devices, but they would come into terminals behind schedule, miss connections, disappoint passengers, inconvenience shippers, and generally create havoc in the well-ordered transportation processes of the country.

With so much at stake, it is small wonder that the railroads have developed precision and uniformity in their timepieces to such a degree that people have come to regard the railroad as synonymous with time accuracy. The factory worker looks at his watch, the housewife checks her clock, as the fast limiteds fly past city, town and countryside. The city motorist, driving to work in the morning past the railroad station, glances at the clock tower to check his watch even though he does not catch a train. The railroad agent and ticket clerk receive scores of telephone calls inquiring about the time.

Conductor comparing time with dispatcher's clock before starting

LET us examine the machinery by which this split-second accuracy and rigid uniformity are brought about. On the Baltimore and Ohio Railroad, a special department handles the job—the "Time Service Department." Accuracy is achieved by this department through a system of standard clocks located in the office of every train dispatcher, and in every terminal where train and engine crews are required to register and begin their work. It is the task of certain designated employees of the company to keep the standard clocks accurate. At noon daily, they receive the correct time by wire from the Federal Government. Should the standard clock be as much as ten seconds fast or slow, it is corrected. Card reports are maintained daily showing the variations in seconds and the corrections made, which are forwarded at the end of each month to the General Offices in Baltimore, where a record is kept of each standard timepiece on the entire system.

Uniformity of time over the system is brought about by rules that require men in many branches of the railroad to compare their watches with one of the standard clocks at certain

Official inspectors at various points periodically examine all railroad watches for accuracy

specified times. These men include supervising officers, such as road foremen of engines and trainmasters; members of train crews, such as engineers, firemen, conductors, and flagmen; employees in the Maintenance Department, such as signalmen, supervisors of track, and track foremen. All these men have something to do with the running of trains and each man must have what is known as a standard railroad watch, the product of any one of a designated group of watch manufacturers, well-known for making timepieces of enduring accuracy. To insure the safe operation of trains, each railroad man's watch must tick in unison with every other watch, or as nearly in unison as the fine craftsmanship of the most skilful watchmakers of our day can make possible.

As a further guarantee of uniformity, employees in the branches of service mentioned must take their watches once each month to an official watch inspector for comparison, and twice each year (April and October) for thorough inspection. For this purpose, the Baltimore and Ohio Railroad has 136 official watch inspectors, all of whom are practical jewelers and watchmakers. Their work has been examined and certified by the Horological Institute of America, a body sponsored by the Bureau of Standards of the United States Government. These inspectors are located accessibly in the cities and towns along the line of road and, with their co-operation, inspection service is kept at maximum efficiency.

While the main tracks of the trunk-line railroads of the country are well protected by modern signaling devices, there are still many miles of single track where trains are permitted to run from block to block with time accuracy —and that means watch accuracy—as their principal safeguard. In emergencies, or on the occasion of violent storms, the signal systems of even the most highly developed main lines may be thrown out of order, and here, again, the unfailing watches in the hands of engineer, conductor, and flagman, are the basis of safe operation.

Most of us, at one time or another, have seen the engineer and conductor of a passenger train standing beside the steaming locomotive at a terminal comparing their watches at the start of a long run. This is a check that takes place hundreds of times a day on the quarter million miles of American railways. The running of trains nowadays, however, is more than the mere job of getting them from one terminal to another on time. Regularity and smoothness of operation all the way are also considered important factors in good railroading. This is why we may often see conductors and flagmen looking at their watches as they pass familiar landmarks, such as towers and stations, along the line, even when passing them at high speed, in order to check the regularity of the run and smoothness of the speed maintained.

NOW we come to another part of the story. Who guides the engineer along the many steel lanes of the railroad, through the dense centers of traffic in the big cities, in and out of busy railroad terminals—always on time? Unlike the motorist, who not only operates his machine but also has a choice of the roads he wishes to follow, the engineer controls only the speed of his locomotive, not the route. It is not his job to "steer." He must follow orders, which are conveyed to him by the highly efficient devices of the modern railroad signaling system. Silently, day and night along his route, lights flash, semaphore arms move, switches turn, controlled by an invisible hand guiding the trains to their destinations. Trace that guiding force to its origin and you will find the railroad train dispatcher sitting at a table in his office, probably poring over his "train sheet."

A superficial glance at the things required of a train dispatcher will convince you that his job is not a simple one. Upon his shoulders rests the responsibility for moving many trains daily in a precise and orderly manner with safety and promptness. In unforeseen emergencies, he must decide quickly what to do to forestall costly blockades and to avoid confusion. It is essential that he possess qualities of steadiness, sobriety, and reliability together with initiative and a capacity for passing rapid, sure judgment on any given situation.

Assigned to each dispatcher's office is a certain portion of the railroad, and all trains entering or leaving that section are subject to his orders. Also subordinate to him are the operators in the towers and telegraph offices located in the territory under his care.

Supplementing the telegraph in dispatching, the telephone has come to be commonly used, so much so that it has long since ceased to be a novelty. With the receiver at his ear, instead of his hand upon the key, the dispatcher keeps in constant touch with operators and towermen.

Anywhere on the circuit, an operator

Illustrations courtesy Baltimore and Ohio Railroad

The dispatcher's office, Baltimore. The telephone plays an important part in this work. On the "train sheet" is recorded the time trains pass telegraph offices

may attract the attention of the dispatcher on the telephone, by saying, for example: "Dispatcher—B-ville." When the dispatcher desires to talk with an operator at a certain location, he "selects" that station by turning the proper key in a cabinet directly in front of him. A bell rings on the operator's end and he quickly answers. Frequently, the dispatcher is in touch with several stations at one time, which is made necessary when orders are issued to trains at different locations.

In his important and responsible work, the dispatcher functions hand in hand with time. The standard clock in his office is his most valuable ally. He uses it constantly in directing and following the movement of trains. He uses the minutes and seconds in planning the routes of trains. And time is also vital to him in making the quick decisions that are always necessary.

Now, specifically, just what does the train dispatcher do? For one thing, he compiles daily an elaborate train sheet, which is the dispatcher's record of the movement of trains in his territory. Operators in the telegraph offices and towers out on the line keep him informed as to the time of trains passing those points and he carefully notes this information on the train sheet. In the case of freight trains, he must ascertain and record the total number of loaded and empty cars in each train and the total "tonnage." These facts, studied in their relation to each other, enable him to tell which trains to side-track and which to let through—in short, to chart the course of trains through his section.

The operators in the dispatcher's office at Tower K, Washington terminal, give orders to the levermen who operate the switches and signals, all interlocked

AS AN example, let us take the *Columbian*, Washington-New York passenger limited of the Baltimore and Ohio, which leaves Washington at 4 P.M. daily. First, we look in at the train directors at work in Tower K, the largest interlocking plant in the Washington terminal yards. A standard clock, conspicuously placed, is the first object that catches the eye. Then we notice above the heads of the train directors numerous miniature semaphores. These automatically indicate the proximity of trains approaching the plant. The four circular dials we see at the right are train describers which operate in conjunction with other plants. Just above the clock is a triple row of numbered circles, part of the train starting system at the terminal.

It is this starting system which particularly engages the attention in connection with the departure of the *Columbian*. The conductor, the train director, and the terminal gateman each has a part in this operation. Along the length of the passenger platform beside which the *Columbian* stands ready to leave, are five posts, each equipped with a metal box containing two lights and a key switch. (Other platforms in the terminal are, of course, similarly equipped.) A two-light set is also placed at the platform gate in plain view of the gateman. The numbered circles in Tower K, the platform lights, and the gate lights have separate functions, all contributing to one end—the starting of the train.

This is how they work: At one minute to four o'clock, the conductor of the train turns the key switch in any one of the platform boxes. This causes one light of a vertical row of the numbered circles in K Tower to burn—the particular row corresponds to the of which the *Columbian* is standing. Noting this signal from the conductor, the train director, when ready to start the train, pushes a button in his cabinet (shown below the clock in the picture) which does four things: extinguishes the top numbered circle light above the director's head, lights the second numbered circle light in the vertical row, turns on the top light in each of the conductor's platform boxes, and illuminates the top globe in the gateman's light set. The conductor and the gateman are informed by this means that the dispatcher is ready to permit the starting of the train. The gateman closes his gate, makes sure that all passengers are on board, and then turns his key switch, located on the opposite side of the gate-post from that on which the lights are placed. The turn of the gateman's key lights the second light in his own set, the second light in the platform boxes, and the third light in the vertical row in Tower K. Seeing both lights burning in the platform boxes, the conductor glances at his watch and at precisely 4 P.M. waves a hand signal to proceed. From here on the engineer is governed by signal indication.

Now that the train is on its way, let us turn our attention to the dispatcher's office in Camden Station, Baltimore. At about twenty seconds after 4 P.M., the dispatcher at Baltimore receives information from the operator in the Washington terminal that the train has de-

Conductor signaling gateman and train director in Tower K. All co-operate in train starting

Gate showing the twin lights at the left which play an important part in all train departures

parted on time, and notes this on the train sheet. As this train passes each telegraph office or tower, the time of its passing is transmitted to the dispatcher and duly recorded.

Suppose, now, that from other facts on his sheet, the dispatcher finds that a long freight train is moving slowly ahead of the passenger train on the same track. The speeding *Columbian* must not be held up. It is on a limited schedule. The dispatcher then instructs the operator at the proper location to divert the freight train over to another track. These instructions are obeyed, which gives the *Columbian* a clear track. After it has passed, the dispatcher notes the fact on his sheet and instructs the operator to allow the freight e its normal course. This comparatively simple operation is only one of hundreds performed daily.

HOW does the dispatcher know which train shall precede others? In this he is guided largely by definite operating rules which specify the superiority of trains, and it follows that in order to give the passenger train a clear track, the freight train would be diverted or sidetracked at the proper time to enable the passenger train to pass without delay. The same is true of freight trains of different classes. For instance, a freight train which carries stock or perishable shipments is considered fast freight and would be given preference in right of way over a train handling ordinary freight.

What is to be done on single track when two trains are to meet? In this case, the rule of direction named in the timetable defines the method of passing. Where eastward trains have superiority they will occupy the main track and westward trains take the siding. When, for any reason, a scheduled train becomes late, it is the duty of the train dispatcher to fix meeting points at such places as will avoid delay to either train.

In certain places, where heavy grades or other operating conditions affect speed, the time of trains between stations may vary greatly, even when the distances are practically equal. In addition to his knowledge of the physical characteristics of the stretch of track under his supervision the dispatcher must keep in mind the location of the passenger and freight stations; the length of the sidings; the points of their divergence from the main track; and other data of this nature. It takes a thorough knowledge of railroading and years of training to keep a clear head in the maze of detail.

When there are many freight trains moving upon the railroad, the dispatcher's job becomes even more exacting. He must be familiar with the class and capabilities of the engines pulling the trains and, as previously mentioned, must ascertain how many cars, loaded and empty, make up each train, together with the total tonnage. If a freight train consists of 100 loaded cars, for instance, and the gross weight of each car is 50 tons, the total tonnage of that train would be figured at 5000 tons. Passenger trains, of course, have precedence over the freights, and this ever-recurring problem of getting the freight trains out of the way becomes more difficult with each increase in the number of trains to be handled.

If traffic becomes dense the dispatcher is kept busy issuing train orders. These orders are sent to the operators at the towers or offices most conveniently located. When it is necessary for several trains at different locations to receive the same order, the dispatcher transmits it simultaneously to the several offices. After the operators receive the orders they repeat them back. The train dispatcher also follows the repetition closely and does not authorize delivery of the order until it has been correctly repeated. This arrangement eliminates the possibility of error.

ANOTHER important phase in the dispatching of trains is a special time table. To the public, the time table is a booklet of information about the arriving and leaving time of trains. But there is another time table, which is used by employees, having to do with the running of trains. This document shows not only the time each scheduled train is due to arrive and depart from terminals and many intermediate points, but also contains special instructions peculiar to local conditions.

It is the dispatcher's efficiency, aided by the accuracy of the railroad clock, which prevents congestion and avoids trouble-making delays. Together, time and the dispatcher bend their efforts toward the dual task of satisfying both the passenger who likes to arrive on time and the shipper who wants his freight to come through as scheduled.

Passenger trains will not exceed a speed of 65 miles per hour.

...ra in Special Instructions, Rule 2, and such

The "working time table" that the public does not see gives such information as train order stations, speeds, superiority of trains, and the length of sidings

OUR POINT OF VIEW

Transportation Control

AT least one president of a large railroad system refuses to be greatly alarmed concerning what is currently known as the plight of the railroads. When we asked him about it recently, he told us that the "problem" of the railroads is principally the depression problem that affects all business and industry just now. He believes that, when general conditions improve, the business of the railroads will improve accordingly.

He told us that motor transportation is taking only about 3 percent of the freight business of the country, and inland waterways only about 2 percent. He recognizes that these modes of transportation have evolved in the natural course of progress and says that any form of control of them is up to the people whose taxes maintain the highways that the trucks use freely and whose government subsidizes the inland waterways. If the people wish to support these two systems of transportation by their taxes—for private gain, of course—that is up to them.

This sounds broad-minded enough but it puts the question squarely up to the people.

Everyone knows well that nothing can ever replace the railroads in the transportation of such freight as coal, for example, except, on particular routes, the inland waterways. But what of general freight, lighter or short haul shipments? Are these to be lost to the railroads? No one blames the shipper for taking advantage of cheaper rates by motor truck or by canal and river, but when the realization comes that each one of us pays taxes to make it possible for that shipper to save money, *that* is a different matter.

Samuel O. Dunn, writing in *The Pullman News* says that in the Ohio River territory, the railways move a ton of freight 100 miles for an average of 88 cents; but by water the cost is $1.25 for the same distance, the shipper paying only 60 cents of this while the public pays the other 65 cents in taxes.

Then let us look at it from a selfish viewpoint; it is manifestly unfair *to us* that this situation should endure. As far as railroads are concerned, our interests have been safeguarded for years by the Interstate Commerce Commission. Is it not possible, then, for the people to create a similar body to watch our interests in connection with other modes of transportation?

The Air Maneuvers

MOST of those who witnessed the Army air maneuvers, beginning with the mobilization in Dayton, Ohio, on May 15 to their completion at Washington on Memorial Day, probably believed that the 672 planes flown represented the most modern equipment in the world. This belief doubtless was strengthened by the fact that there was not a casualty and only two or three minor accidents to planes although the total plane-hours flown was 37,000.

As a matter of fact, the 672 planes were practically all those available in the country; and those used as light bombardment machines were actually comparatively low-priced training planes. If we had carried out fully the five-year program for military planes and equipment, at least 1500 modern and most efficient craft would have been available.

What the air maneuvers did show conclusively was that we have a trained and competent personnel second to none in the world; and that the United States takes first place so far as the operation of large units is concerned. From the maneuvers we learned the strategically important fact that commercial airports may be utilized in time of war for military aircraft. Given proper equipment, therefore, our Army's air force could do most satisfactorily its part of the job of defending the country in wartime.

Rain Makers

IT is again open season for a certain kind of hunter. He is most likely a polished personage with personality, a convincing tongue, and a lot of mysterious apparatus which seems to be of an electrical nature. The hunter is the "scientific" rainmaker; and his game is anybody with more money than knowledge of science who either wants it to rain or doesn't want it to rain on some specific occasion.

Farming communities have been known to pool their spare cash and put up large sums of money to try out rain making devices. Huge guns have been fired toward the heavens and various kinds of electrical machines have buzzed out their call for rain so that parched crops might drink. On the other hand, organizations such as those that operate race tracks, fairs, or other outdoor gatherings have paid the rain controller large sums to prevent rain. Bear in mind that money has a lot to do with this modern magic.

To our knowledge, nothing of any importance has ever been done in the effort to control rain. If some apparent success has been attained, it may be put down as negligible or the result of chance. It is not at all likely that pseudo-scientists with nondescript equipment can or will do what scientists with their specialized knowledge and superior apparatus have tried and failed to do. If someone does find even a partially successful solution to this problem, it will first be tested thoroughly by men of science who know what they are about. In the meantime, gullible ones will perhaps continue to pay their good cash for nothing. Rain insurance would be just as satisfactory—just as good a gamble—and much cheaper.

Death to Children

IN connection with the peace-time use of explosives, two significant facts stand out. The first of these is that during the past four years, one half billion pounds of dynamite and black powder have been transported annually by the railroads of the United States and Canada without the loss of a single life and with but negligible property damage. The second is that about 500 children are killed or injured every year while playing with blasting caps.

The blasting cap is a necessary auxiliary of dynamite, and its very appearance and size make it attractive in the eyes of children. It is a copper shell about a quarter of an inch in diameter and one or two inches long, half filled with fulminate of mercury. Flying particles of copper from this cap, when it is exploded, will imbed themselves in iron a foot away and will blow a hole through one sixteenth inch steel plate.

Blasting caps are so small that they are easily mislaid or lost, especially by careless workers. Thus it is that children find them where blasting work has been going on and, in playing with them, accidentally strike them against something or investigate their contents with disastrous results. Many fingers, the sight of one or both eyes, and even lives are lost as a consequence.

We cannot urge too strongly that extreme care be taken by those authorized to handle these dangerous little "ferrules." They should be kept under lock and key and the loss of even one of them should never occur. Furthermore, parents should explain to their children just what they look like so that the children may avoid them entirely.

Carl Akeley and George Eastman, expedition sponsor, in Tanganyika

CARL AKELEY'S AFRICA

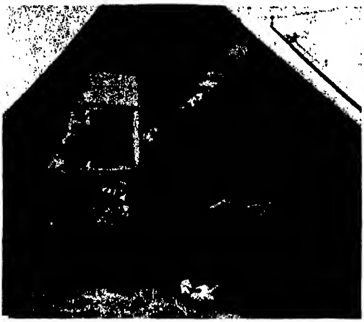
FIRED with the enthusiasm of a crusader, endowed with the technique of a sculptor and governed by the balance wheel of true artistry, Carl Akeley has left behind him monuments of such imposing grandeur as it has been given to few men to excel.

The great African Hall of the American Museum of Natural History, soon to be opened, and the permanent establishment of the Parc National Albert in the Belgian Congo as a sanctuary for wild life, particularly gorillas, represent the outstanding attainments of one of the greatest naturalists that ever lived. In the former will be found all the dominant forms of the mammalian life of Africa in settings which give a comprehensive idea of the scenery and environment, with a truth and accuracy which only such an exceptional personality could weave into the inanimate setting. In the Parc National Albert will be preserved for all time, because of the beneficence of His Majesty, Albert, King of the Belgians, the beauty and grandeur of the pre-civilization and the wild life Akeley loved to photograph, paint, model, and conserve. Here, too, most appropriately, his body lies at "home," as he used to call this country.

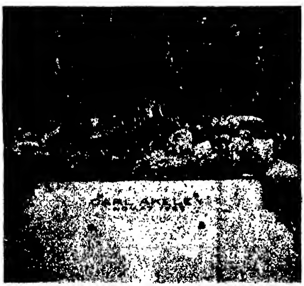
Carl Akeley was undoubtedly the world's greatest taxidermist. He was also a sculptor of high order, and inventor and explorer of note. He first went to Africa in 1905 for the Field Museum and in 1909 for the American Museum of Natural History. In 1924 he married Miss Mary L. Jobe who had already made a name for herself as an explorer. She accompanied her husband to Africa in 1926 as secretary and expedition manager for the Akeley-Eastman-Pomeroy African Hall Expedition of the American Museum of Natural History.

Shortly after the arrival of the party in the Belgian Congo, Carl Akeley died on November 17, 1926 and his wife buried him on the slope of Mt. Mikeno. Mrs. Akeley bravely carried on the aims of the expedition for several months.

About a year ago it was our pleasure to review briefly a most fascinating book on Africa entitled "Carl Akeley's Africa: the Story of His Last Expedition" by his wife. Now we have another book entitled "Adventures in the African Jungle" partly written by Mrs. Akeley and partly made up of stories which the great naturalist delighted to recall and relate to friends both old and young. While this book



Carl and Mary L. Jobe Akeley in their camp in the Lukenia Hills, Kenya Colony, making a sketch model of a group of rare Klipspringer



Carl Akeley's grave is in the Parc National Albert on Mount Mikeno in the gorilla country of Belgian Congo

In the Parc National Albert the mountain gorillas feed on wild celery. The forest is a fairyland of moss and ferns

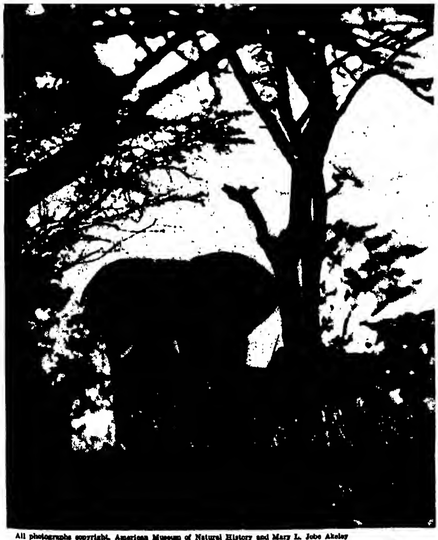
is primarily intended for juvenile reading it is filled with interesting anecdotes and information which render it an ideal book for adult reading as well. Through the courtesy of Mrs. Akeley and the publishers, Messrs. Dodd, Mead & Company, we are able to present a number of illustrations from these two books.

"Carl Akeley's Africa" is an account of the last expedition. It pictures the struggle of the great game herds of Africa against the rush of civilization. Mrs. Akeley says: "During the five weeks which Carl and I spent in the so-called heart of the lion country of western Tanganyika, we saw 146 lions. Not one of them evinced the slightest inclination to be aggressive unless wounded. Without exception they conformed to the creed my husband formulated: '*The lion is a gentleman:* if allowed to go his way unmolested he will keep to his own path without encroaching on yours.' "

That all the large animals are dangerous is contradicted by Mrs. Akeley, who says: "The ends of conservation may further be served by ridding the minds of travelers of the fallacious notion that all large animals are aggressive. Only once during 13 months of hunting in the remote regions of Equatorial Africa was a shot fired by any member of our party in self-defense."

Anyone who reads this book will gain a fresh point of view as regards the personalities of animals as well as of the natives of Africa. The descriptions of the collisions between nature and civilization are well worth while. Who, for example, would think that the very dumb giraffe mowed down telegraph wires until World War combatants in that section had to stop fighting among themselves until they could get rid of the long necked pest?

Mountain gorillas collected in the Congo and mounted by Carl Akeley for the American Museum of Natural History



This cow elephant charged Mr. Akeley and was taken by him at 75 feet just as the elephant started to charge. He was once nearly killed by an angry elephant

During 1921 Akeley made an expedition through the Belgian Congo and visited the mountainous gorilla country lying in the Kivu district in a triangle between three extinct volcanoes, and became so impressed with its possibilities as a sanctuary for all forms of wild life, he at once began an agitation to have this region declared a royal park prohibited to all game hunters. King Albert, by royal decree, created the Parc National Albert in 1925 and this was followed by the reservation of 500,000 acres with a plan of organization and administration.

MRS. Akeley refers to the gorilla country as follows: "On the cool wooded slopes of extinct volcanoes and ranging side by side with the gorilla and at peace with him are herds of elephants and buffalo; here, too, are leopards which sometimes menace the gorilla's young."

Challenging the misconceptions of generations, but fully authenticated by recent studies of accredited scientists, stands an impressive gorilla group in the new African Hall, a tribute not only to a unique method of taxidermy developed by Mr. Akeley, but also to a score of years of prolific activity.

To accomplish such perfection of reproduction and to rest at last in the country and among the animals he loved to preserve and conserve, Carl Akeley surely represents the meeting of science and romance.

WHICH SHALL INHERIT THE EARTH— MAN OR THE INSECTS?

By L. O. HOWARD

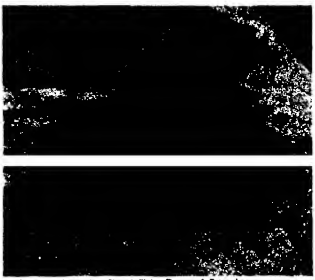
I HAVE raised this question because it has become perfectly evident to me that insect damage is rapidly increasing and because almost no one seems to realize it. I have written and lectured on this topic very considerably, and have urged my colleagues among the entomologists and my friends among the magazine and newspaper writers to display the danger as much as possible.

Probably most people who have read one of these articles have merely shrugged their shoulders and considered it as simply one more attempt at sensationalism. Others may have given the matter some thought, and surely the whole effort has done good. I have no desire to frighten anyone unnecessarily, and I surely believe that the insect menace will be conquered by the human species eventually. But that will not come about until the danger is appreciated, and I am trying to bring about this appreciation as speedily as possible and well before disaster comes.

IT is a fact that insects destroy from one tenth to one fifth of all of our crops. It is a fact that with many crops the present agricultural methods are exactly fitted to encourage insect injuries. It is true that in feeding our increasing millions we are feeding increasing billions of insects. It is true that the labor of one million men each year in the United States is lost through insects, and that the money loss exceeds two billions of dollars annually.

Not only do insects harm humanity by eating the growing crops, but they are supporting themselves and increasing at our expense in countless other ways. They ruin all sorts of stored products—grains, dried food of all kinds, clothing, rugs and carpets, furniture, our dwellings, and even our drugs and medicines. The damage to stored foods is enormous, in mills, on railway trains, on docks and on shipboard. In times of great emergency, like the World War, such damage not only is keenly felt but may result in death by starvation to great numbers.

Then, too, insects damage our livestock and carry disease to both man and his domestic animals. Insect-borne diseases have decimated great populations. Witness the great plague years of Europe, the plague and cholera still existing in oriental countries, the yellow fever epidemics of past times, and the hundred million dollars a year loss at the present time in the United States from malaria. Moreover, of late years it has been discovered that with many of the diseases of useful plants certain insects are the accidental or necessary carriers, so that of the many millions of dollars lost every year by plant disease insects are implicated in at least a large share of the loss.



All photographs courtesy United States Bureau of Entomology

A single day's catch of Japanese beetles from 500 traps. Man's invention of agriculture was a boon to the insects

This tremendous loss from insects has been growing greater year by year. It is true that we have at least temporarily conquered some of the great pests, like the grapevine Phylloxera which threatened the extinction of the wine industry; like the fluted scale which bid fair to ruin the citrus industry; like the cotton boll-weevil which drove cotton planters in this country to despair. But others are constantly appearing, like the Japanese beetle, the Mediterranean fruit fly, and the European corn borer; while the locust plagues in old-time proportions devastate very great areas in certain countries from time to time, driving large populations almost to starvation. Three or four years ago this was the case in certain Central American countries, including the southeastern states of Mexico, and only last year eastern Egypt, Palestine, and Transjordania succeeded in repelling an enormous invasion coming from the east just as did its remote ancestors in the time of the biblical

How is it that the insect type of life is so successful? How is it that, without intelligence, without conscious organization, without individual bulk or great strength, and without any artificial weapons, insects are able to compete with man who has exterminated or subdued all other

Children in Japan engaged in collecting Japanese beetles which are the victims of parasites, as part of an attack on other beetles by a

types of life except the organisms which cause disease?

In the first place the insect type is infinitely older. It is a type that had become perfected by evolution and adapted to an enormously varying environment millions upon millions of years before the higher vertebrate type appeared. Here, also, is another point that is overlooked: An insect may have many generations in a year, whereas man has only one generation in many years. Chronologically speaking, therefore, evolution works very much more rapidly with the insects. To take an example: The cotton boll-weevil has been in our southern cotton fields for about 35 years. That means, say, two generations of man, but 136 generations of the weevil; so that in the same period of time evolutionary forces have been working on 68 times as many generations of the insect.

This rapidity of development is accomplished in many ways and is complemented, with many forms, by enormous powers of multiplication. It has been shown, for example, that the whole ponderable mass of humanity now on the globe would be outweighed very many times by the offspring during a single summer of a single cabbage plant-louse, if all these offspring could be provided with enough food and were not killed by their natural enemies.

NATURE, since life began on earth, has tried an infinite number of experiments, and the two that have succeeded transcendently are man at the head of the vertebrate series and insects at the head of the arthropod series. They co-exist today, each at the head of its own phylum, and each has evolved characteristics that make it the potential master of other life. In the possession of what we term intellectuality, man has an enormous advantage that will lead to his eventual domination. But in every other characteristic the insects have the great advantage.

Few people realize the great advantages of the structure of the insect body over those of the structure of the mammalia, perhaps especially man. In the evolution of vertebrates, primitive forms were small, and these animals worked towards self-preservation by the accumulation of strength and bulk—the forms which fed on vegetation increasing in bulk, as a protection against the smaller flesh-feeders, and the flesh-feeders increasing in strength in order to overpower the larger plant feeders. This resulted in gigantic, highly specialized forms. But, of course, with the changing of conditions these animals were not able to adapt themselves, and died out very largely, and only the smaller vertebrates have persisted. With insects, the shortness of the life cycle and the rapid cessation of growth of the individual prevented the development of great size, and the evolution of insects has proceeded in the opposite way—they have been growing smaller and smaller and more highly specialized.

The peach borer in its galleries at the crown of the peach tree, where it does heavy damage

With the vertebrates, the skeleton is inside; with the insects, the skeleton is outside, and this has been a great source of help in evolution. A Russian author (Chetverikov) has worked out the superior strength of the limb of an insect, and he has done this as an engineering problem. He arrived at the conclusion that the vertebrate limb, other things being equal, is three times weaker than the insect limb. The exterior skeleton affords an endless opportunity for the development of external characters, giving rise to the extraordinary variety of insects as they exist today. In addition, the substance of which the insect skeleton is composed is of great advantage. It is chitin, a peculiar substance that looks like horn. It is an albuminoid, and differs from horn in important particulars. It burns without shriveling, and is attacked neither by alkaline solutions nor by dilute acid. It contains no sulfur, as does horn, and does not grow brittle with age, like the bones of vertebrates. It covers and protects the insect's entire body. With man, the muscles are exposed to the slightest injury, since they are attached to the inner bone. But with the insects they are covered and protected by the chitinous skeleton, and they function better than the muscles of man, since they have numerous attachments to ridges on the inner side of the chitinous covering. The insect skeleton is hard to break; it bends, and it is lighter and stronger than bone.

The largest of all our native caterpillars, popularly called the "hickory-horned devil"

Much of the insect skeleton is composed of waste material, which is thus used to a very good advantage instead of being expelled from the body. The chitin chemically is a complex of nitrogenous sugar groups, while the bony skeleton of man is composed largely of proteids and inorganic materials, chiefly lime and phosphorus. Now it happens that the starches and other substances that make the chitinous skeleton of insects abound in nature, while man's diet must be carefully selected so as to include the substances needed in the growth of bone.

ASIDE from the skeleton and its appendages, all the rest of the anatomy seems to adapt insects better for a mundane existence. The anatomical arrangements for carrying on the vital functions of circulation, respiration, and digestion are notable in contrast to ours. And the muscles of insects function much more efficiently than do those of the vertebrate animals. A man would be able to jump an eighth of a mile if he could leap as many times his own length as do certain insects. Instead of being concentrated, as are our lungs, the breathing tubes penetrate to every part of the body, carrying oxygen to every part of the organism, and the obstruction of a tracheal branch is, therefore, not a very serious matter to an insect. As to circulation, there is no real heart; there is a dorsal vessel extending the whole length of the body. There are no small arteries or veins, the blood circulating free in the body cavity. A slight wound, even to the dorsal vessel itself, never causes death from bleeding. The nerve centers of an insect are distributed throughout the body instead of being concentrated in its head.

With all these anatomical and physiological advantages, it is not strange that insects seem to be less susceptible to disease than are the higher animals. It is true they sometimes have their internal parasitic diseases, caused by

micro-organisms and toxins that may carry them off in great numbers. Of this a notable example is the silkworm disease known as pebrine, which at one time threatened the extinction of the domestic silkworm of commerce. But we have been unable to utilise any of these insect diseases in our warfare against the creatures.

Notable among insects' advantages and supplementary to their small size, rapid multiplication, and rapidity of motion, is their extraordinary power of concealment. This has developed in the course of ages of evolution, and this evolution has depended upon a multitude of factors. They have been brought into such close resemblance to their general environment and to specific features of their environment that they are often concealed in a most perfect manner. Protective resemblance has worked with other animals, as has been especially pointed out by the late Abbot H. Thayer, who was both an artist and a naturalist, but it is with insects that we see the most extraordinary things in the way of protective coloration, and far more in the way of protective structure. We have only to think of the walking-sticks and the leaf-insects and those extraordinary Indian butterflies which when their wings are folded resemble dead leaves. Equally striking instances occur almost unnoticed all around us; for example, the so-called measuring worms which hold themselves at a proper angle from the twigs upon which they have been crawling, and from their color and position resemble twigs themselves. There are leaf-hoppers that resemble the thorns of the plants on which they live. Nowhere in nature do we find anything to compare in number or in perfection with the phenomena of this sort that occur among the insects.

HERE then is a very ancient type of life that for many millions of years gradually perfected a structure and a physiology so perfect that it has endured for many millions more. It has passed through changes and cataclysms that have wiped out many other types. Now suddenly (geologically speaking) within half a million years an entirely different type—the erect mammal called man—has increased and spread and calls the earth his own. Although, as compared with the insect type, he is a poor creature, he has evolved a wonderful mind and has rapidly come to control and to use to his advantage nearly all the other kinds of life. But he has measurably overlooked the insects. The insects, however, have not d him, but have utilized every single new chance he has given them for enormous multiplication. The progress of mankind from barbarism to civilization and so to world control has been accompanied by an always increasing number of insect plagues. He

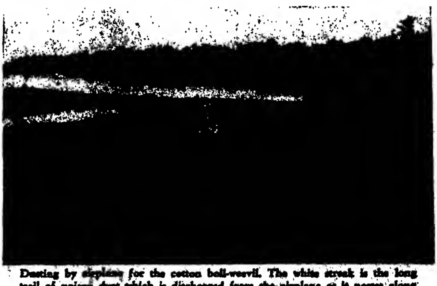
Man's allies. Cocoons of a parasite attached to a tomato worm which will eventually die

has always fed (not cherished) insects, and now he feeds them on a perfectly gigantic scale, and the frightful loss from insect damage is the greatest of all wastes.

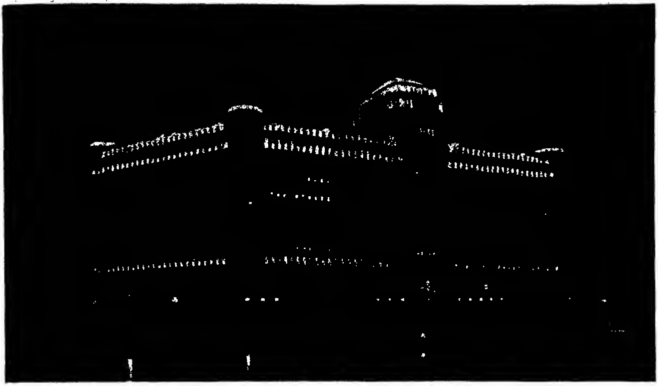
It is not so long ago that seemingly wise prophets were predicting starvation from over-population within a comparatively few years. I think, in fact, that one author selected the year 1933. But the attitude of the knowing ones has changed. Authorities like Sir John Russell of the Rothamsted Experiment Station in England and Dr. A. F. Woods, Director of Scientific Work of the United States Department of Agriculture, in recent addresses went quite to the other extreme and inferentially predicted an ample food supply for hundreds of years to come. This change of attitude has been brought about by discoveries in the scientific investigation of the problems of agriculture. Plenty of food, therefore, is apparently in sight, to the minds of these men who apparently have either not considered the injurious insect side or have taken it for granted that the economic entomologists and other scientific men will solve all such problems.

Accepting, as we should (considering their very high standing as investigators and thinkers), the optimistic statements of these later prophets, we cannot ignore the continuing increase of the insect hordes. We cannot overlook the fact that they seize every chance that we give them, and that in our efforts to grow food quickly and on a larger scale we usually give them a chance to increase beyond bounds.

FROM all this we cannot avoid the conclusion that humanity must at once give great attention to the insect problem. We have begun to do this, perhaps especially in the United States where the danger under present conditions is more acute than in some other countries, like those of Europe, and there are now with us many hundreds of well trained men working under the state and under the federal government. But these men, for the most part, are working for the quickest relief and on emergency projects, and we need thousands where there are hundreds today. We need them at work not only on the great emergency problems but also upon the basic problems. We must know everything possible about insects. Entomologists must do this, and then, based upon the knowledge thus gained, we will often have to do things very differently. Agricultural engineers, the broad students of farm management, the agronomists, so-called, will be able to develop in many cases new methods of crop culture which will avoid the insect danger, and then, with able minds calling in the help of chemists and physicists, we may in many cases be able to launch mass attacks that will be effective. In the meantime, plant physiologists, including the plant breeders, will be developing resistant crops.



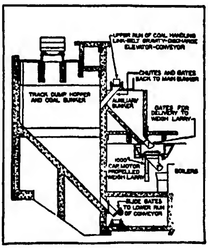
Dusting by airplane for the cotton boll-weevil. The white streak is the long trail of poison dust which is discharged from the airplane as it passes along



The Merchandise Mart is only 18 stories, but there are 4,000,000 square feet of floor space accommodating 30,000 p

A $35,000,000 BUSINESS HOME

CHICAGO has recently added to her collection of "largest" enterprises an immense building called "The Merchandise Mart" which accommodates 30,000 workers housed in 91.8 acres of floor space. The cost was approximately 35,000,000 dollars. The distinction of being the largest building in the world is transitory, for a larger structure is now being constructed by the Port of New York Authority as an inland freight terminal. While The Merchandise Mart is only 18 stories in height with a six-story tower, there



Courtesy Link Belt Company

***Below:* Gravity discharge elevator-conveyor in boiler room. *Right:* Diagram showing coal handling equipment and the coal bunkers**

The Chicago tunnel system handling a car of ashes, saving carting

are 4,000,000 square feet of floor space. One floor of this building contains an area equal to the total floor space available in a 10-story building of the average Chicago skyscraper ground dimensions. It occupies a ground area 724 feet long and 324 feet wide. The underlying idea is to have a structure so vast that merchants can do much of their buying in a central mart. We illustrate some of the mechanical features, and the connection with the Chicago tunnel described in our September, 1930 issue.

WORLDS FROM A CATASTROPHE

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

NATURE has been kind in presenting us with a few relatively simple problems in which some of the great processes can be studied almost free from complications caused by the others. A classic instance is found in the motions of the planets, which are so far apart in practically empty space that we may safely venture the radical simplification of treating them as mere material points moving under gravitational forces alone. Even when so simplified it takes years of work to calculate the motions of a pair of bodies such as Jupiter and Saturn, and the mathematical methods (involving the use of infinite series) are such that, though we can be sure that these results will predict the motions with great precision for hundreds of revolutions to come, we cannot be quite sure what changes will happen after they have made millions of circuits of their orbits.

Courtesy Mount Wilson Observatory

A spiral nebula with arms suggesting the "filament" of Professor Russell's discussion. This is *not* a solar system in formation—these *never have been discovered—but* a whole island universe of suns. It serves only as a rough analogy

But, along with these "easy" problems and sometimes as a part of them, Nature sets us riddles that remain unanswered. One of these is: How did our planetary system get there? It is obviously no accidental conglomeration of bodies; the planets all go around the sun in the same direction and almost in the same plane, most of them in nearly circular orbits; the largest planets are near the middle in order of distance from the sun, while the innermost and outermost are small; most of them are in rapid rotation and the rotation is in nearly the same direction as the orbital motions, except for Uranus where it is at right angles to it; and six of the nine large planets are the centers of satellite systems which reproduce the solar system in miniature with interesting but not radical variations in plan. Here we have traces—nay definite evidence—that some orderly process forms the whole. But have we enough on which to work backward and make out the process clearly?

The old hypothesis of a slowly contracting, flattened nebula which left behind as it shrank rings of matter which somehow coalesced into the planets, perished late in the last century from incapacity to explain why the planets, which altogether make up but 1/700 of the mass of the system, have more than 98 percent of the momentum of rotation or angular momentum. In an isolated system the sum total of this angular momentum is fixed in amount—internal processes can transfer from one part to another but can neither *create nor destroy* it—and no one has ever been able to explain how, without external influence, almost the whole angular momentum could have got into so tiny a part of the material.

This led Professors Chamberlin and Moulton of Chicago, about 30 years ago to revive and support by reasonable and convincing argument the theory that the planets owe their existence to a catastrophe. Long ago, three or four thousand million years ago as we have now good reason to believe, our sun was an isolated star, till some other wandering star passed near it and was drawn in by their mutual attraction so that the two bodies passed in a hyperbolic orbit within a few million miles of one another. The enormous tidal forces caused the ejection of vast masses of the solar material. Some of these fell back, others may have flown off into space, but a good part was set into motion sidewise by the attraction of the now receding star and condensed into a system of planets all moving around the sun in the same general direction.

In this generalized form the hypothesis is accepted by practically all students of the subject. Nothing short of an encounter with a visitor from outside appears to be capable of putting the angular momentum into the motions of the planets which we actually find there—at least no rational alternative has yet been suggested.

But the details of the process are very puzzling and there is lively disagreement about them. Chamberlin and Moulton concluded that the material ejected from the sun came in huge eruptive bursts like those from a volcano and that these "bolts" cooled down to form swarms of small solid bodies or "planetesimals."

COMPACT swarms of these bodies gradually consolidated into the nuclei of the planets and grew by slow accretion till they had swept up almost all the smaller bodies and reached their present size.

An alternative form of the hypothesis, suggested later by Sir James Jeans and Dr. Jeffreys, concludes on dynamical grounds that the material escaping from the sun flowed out of it under the tidal pull of the passing star, rather than escaping by paroxysms, and formed at first a long and nearly continuous ribbon or filament. Shortly afterward this broke up crosswise into parts, somewhat as a thin falling stream of water breaks into drops. The middle and thickest part of the filament forms the largest masses—Jupiter and Saturn; the thin ends the smallest—Mercury and Pluto. The attraction of the receding star set these masses in lateral motion as they separated, so that they did not fall back into the sun but formed planets.

On both of these hypotheses it is difficult to account for the rapid rotation of the planets. The infall of each planetesimal on a nucleus would tend to produce rotation, but the numbers

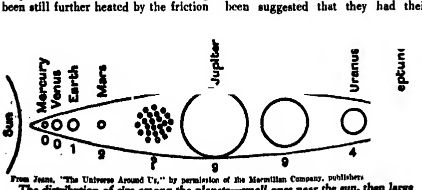
striking it on one side and on the other would be nearly equal and their efforts would merely annul one another, so that the rotation of the final mass should be slow unless the circumstances of infall were highly specialized. It is harder still to see how the material of the filament of matter pulled out from the sun by tidal action could be at the same time set into rotation fast enough to account for the fact that Saturn makes some 57 revolutions and Jupiter more than 60 while the sun turns around once. Many of the asteroids are turning still more rapidly. Eros rotates 112 times as fast as the sun. In this last case the rapid rotation as well as the irregular form of the planet may be due to a later encounter between two asteroids, as was mentioned last month, but nothing of the sort can be assumed for the great planets.

DR. JEFFREYS has recently suggested that this difficulty may be met by supposing that the planet-forming star actually collided with the sun, making neither a clean central hit nor a glancing graze but something between. During the actual impact, which must have lasted less than an hour owing to the enormous orbital velocity, the material of both star and sun in the zone of actual contact would have been stirred up with extreme violence, and if one mass slid by the other the intervening layers would have been dragged along and set into rotatory motion. They would have streamed out after the star as it receded, and formed a turbulently eddying ribbon or filament of matter which would "be unstable in a complicated way," and break up within a few hours into separate masses.

All the ejected material would be intensely hot, coming as it did from the deep interior of the sun and having been still further heated by the friction of one mass upon the other. Jeffreys considers that its temperature at the moment of ejection may have been as great as 10,000,000°. Once exposed to space it would cool very rapidly, at first mostly by radiation but also by expansion, so that when it settled down into more or less independent masses these would be very much larger than at first —larger than the sun itself if it were not for the loss of heat by radiation and low density.

In such a mass the more refractory constituents would condense, forming raindrops, not of water but of molten metal or rock, and these would fall toward the center and collect into a liquid planet, while the lighter gases would remain as a far-extending atmosphere. A small planet would not have gravitational attraction enough to keep this atmosphere or at least its lighter constituents from diffusing away into space, while Jupiter and Saturn must have retained a great deal of it, accounting for the low density as Moulton long ago suggested. Jeffreys concludes that drops of molten matter would begin to form in about a day for the earth and a week for Jupiter, and that the collection of these into liquid planets "probably took a few years for Jupiter and some days for the earth." It should be emphasized that all these theories are closely related. They differ regarding the details of the process rather than their general nature, and there is no necessary antagonism between any of them. The "ribbon" of matter torn loose by an actual collision has much similarity to that postulated by the theory of tidal action without collision, and in both cases there would doubtless have been formed immense numbers of small bodies like the planetesimals. These, by collision with the planets, caused their orbits to become less elongated and gradually to approach a circular form.

Moreover, none of the three hypotheses is completely satisfactory. All of them have difficulty in accounting for the satellite systems, especially for the beautiful miniature solar systems which center on Jupiter and Saturn. It has been suggested that they had their origin in condensation in a planetesimal cloud, or were ejected from the masses condensed from the tidal filament when next these came close to the sun and under its powerful tidal influence; or were born during the break-up of the turbulent ribbon ejected by an actual collision. But in no case have the details of the process been satisfactorily worked out.



From Jeans, "The Universe Around Us," by permission of the Macmillan Company, publishers

The distribution of size among the planets—small ones near the sun, then large ones, then smaller ones again—suggests that the filament may have been cigar shaped before it condensed into the "independent masses" described in the text

Another difficulty common to the three theories is this: If the newly formed planets were of approximately their present masses and carried nearly the same amounts of angular momentum as they do now, it follows from elementary principles of theory that the perihelion distance of each one must from the beginning of its really independent existence have been at least half of its present mean distance. Otherwise the orbit would have been a hyperbola and the planet would have been lost in the depths of space. This means that Uranus must from the first have been always as far from the sun as Saturn now is and Jupiter farther than Mars even is now. How these great masses could have been removed so far from the sun shortly after the original encounter is difficult to imagine. It is easy to show that the shortest time in which a body can be taken from the sun to any given distance, without moving it at such a speed that the sun's attraction would be unable ever to bring it back again, is 7½ percent of the period of a planet rotating in a circular orbit at this distance. To get Neptune out to half its present distance must therefore have taken more than four years, while Jupiter would require about four months.

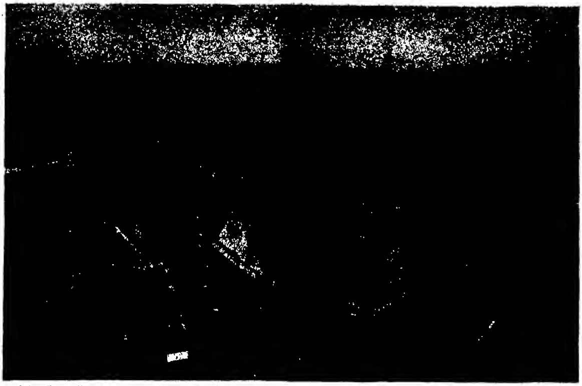
THESE are roughly the lengths of time which the passing star would have taken to recede to the sam tances, and this suggests that the planets may represent masses which started to trail after the star and only gave up the chase after some time. In this case the elementary calculations just described are no longer applicable, and the far more intricate ones which tell what could actually be expected do not appear to have been made. After the star had once gone its way it is very hard to see how the planets could have been shifted much farther from the sun.

It may well be that the surviving planets represent but parts of the matter originally thrown out, which, by a favorable combination of circumstances, were dragged to a considerable distance and set moving laterally, while the amount which fell back into the sun or followed the star into the unknown was much greater.

There is a great deal still to be found out before we have a really satisfactory theory of the origin of our planetary system, but real progress appears to have been made and our present cosmogonists, though differing vigorously on details, are by no means to be compared with Browning's poet-philosopher who boasted,

"And I have written three books on
the soul
Proving absurd all written hitherto,
And putting us to ignorance again."

—*Princeton University Observatory.*

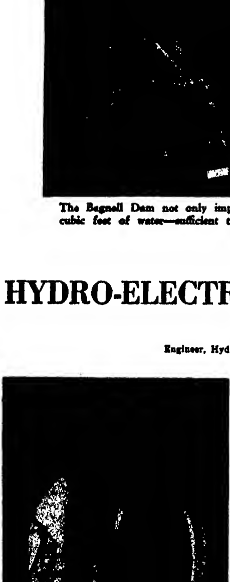


The Bagnell Dam not only impounds 87 billion cubic feet of water—sufficient to generate about 425 million kilowatt-hours of electricity annually—but also serves as a bridge over the Osage River

HYDRO-ELECTRIC POWER IN THE OZARKS

By A. J. SEABURG

Engineer, Hydraulic Division, Stone & Webster Engineering Corporation



An inspection walkway more than 500 feet long extends along the downstream side of the 12 Tainter gates in the dam

FROM a drab, sluggish stream, winding across the western central part of Missouri, the Osage River has been transformed in a single year into a sparkling blue lake 129 miles long and with 1300 miles of attractive shore line. This transformation has been brought about by the construction of a great concrete dam, known as the Bagnell Dam which is part of the 129,000 kilowatt power development for the Union Electric Light and Power Company and which is now being completed by the Stone & Webster Engineering Corporation.

Located in approximately the center of the state, the dam is about equally distant from Kansas City and St. Louis. The lake, held closely within the confines of the rocky bluffs of the old river channel, winds among the foothills of the northern edge of the Ozark plateau and on the map somewhat resembles in shape a great sprawling Chinese dragon.

The Osage River brings the drainage from 14,000 square miles of gently rolling country to the reservoir which has a storage capacity of 87 billion cubic feet of water. In the spring of the year floods sometimes come with the rush of 110,000 cubic feet per second but at other times the river flow dwindles to only a few hundred cubic feet per second. This irregular flow is smoothed out by the large capacity of the reservoir so that the power which the river can deliver in an average year will be about 425 million kilowatt hours. This ordinarily will be used to fulfill system peak load requirements and during periods of plentiful river flow the plant may be operated as a base load plant.

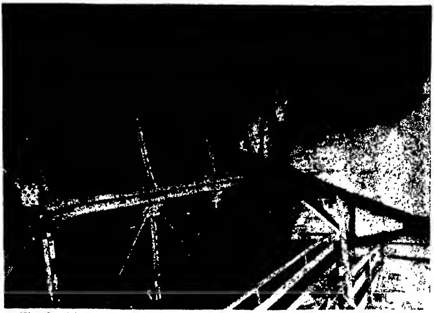
THE development consists of a solid concrete dam of gravity section and a power station built integral with the dam. The dam is approximately one half mile long and has a maximum height of 148 feet from bedrock to the floor of the bridge over the top of the dam.

The power station section, which is located in the old river channel, is 511 feet long. At the left of the power house, looking downstream, is a short retaining section and at the right is a spillway which is 520 feet long. From the spillway to the right bank is the main retaining section. The dam is surmounted by a roadway which serves as the river crossing of United States Highway No.

54 which formerly crossed the river on a ferry. An inspection tunnel is built into the dam above the ordinary level of the water downstream for most of the length of the dam.

The spillway section is equipped with 12 Tainter gates, each 34 feet wide by 22 feet high, weighing 54,000 pounds. These gates will be used to discharge flood waters over the concrete portion of the spillway and to regulate the reservoir water levels. When they are all raised they will permit 156,000 cubic feet of water per second to flow over the dam.

The power house, which is built as part of the dam, consists of a headworks or intake section, an electrical bay, and the main operating room. In addition, space is provided at the east end of the power house for the assembling and dismantling of equipment, machine shops, offices, and other auxiliary service equipment. Provision is made for eight wheel units and t iary units. The steel head gate for each main unit is 27 feet high by 27 feet wide and weighs 137,000 pounds.



The flood level of the reservoir is regulated by 12 Tainter gates which, when closed, rest on the crest of the concrete spillways. Gantry cranes raise them

THE electrical bay is located between the headworks section and the operating room and contains the electrical apparatus with the exception of the main transformers, the high tension disconnecting switches, the lightning arresters, and carrier current coupling condensers, which are located on the roof.

The operating room is located adjacent to the electrical bay and is of particular interest in that the superstructure ordinarily provided over the generating units has been omitted and the usual operating and turbine rooms have been combined into one room. The omission of the superstructure effects a material saving and is made possible by the use of umbrella type generators in which the main bearing is not located on top but beneath the rotating part of the generator. Each main unit is provided with a metal cover which projects just above the roof of the operating floor. The entire cover is removed when complete dismantling of the unit is required and a small circular hatch in the cover permits general maintenance work on the generators.

The six main water-wheel units are the vertical shaft, Francis type, and have a rated capacity of 33,500 hor under the normal head of 90 feet and revolve at 112.5 r utions per minute. Each wat vheel is direct-connected to umbrella type generator, rated 23.888 kva., at 0.9 powe factor, 13.800 volts, three phase, 60 cycles.

The two gantry cranes which travel the length of the power house and spillways and operate both the head gates and the spillway gates

Courtesy Allis-Chalmers Manufacturing Company

Shop-assembly of one of the scroll cases. It is 19 feet in diameter at its larger end and will deliver 4000 cubic feet of water per second to the water wheel

The power output is transmitted at 132,000 volts by means of three-phase transmission lines. One extends to the Page Avenue substation in St. Louis, a distance of 136 miles over right-of-way which was purchased sufficiently wide to permit the construction of another single circuit line in the future. A double circuit line 120 miles long is built to Rivermines and is connected at that point to a smaller line from the large steam power station in St. Louis known as Cahokia. Rivermines is a central distribution point for the lead district.

The problem which confronted the engineers was to build the plant and deliver power to St. Louis in the short space of two years and four months.

This involved the control of the river; the excavation of 920,000 cubic yards of earth and rock; the placing of 551,000 cubic yards of concrete; the construction of two transmission lines, the shortest one 120 miles long; and the preparation of 95 square miles of reservoir area which in surveys alone included the staking out of more than 2500 miles of line.

A railroad four and a half miles long with a bridge across the Osage River was extended from Bagnell to the site of the work. A village was established on the bluff above the river to accommodate 1200 men and 73 families. The living quarters consisted of bunk-houses to accommodate 28 men each; 10-room foremen's bunk-houses having individual rooms for each man; and family cottages. A central mess hall was equipped to care for 960 men at one time with provision for extension to an ultimate capacity of over 2000. A club house, hospital, school, and miscellaneous service buildings completed the village which was equipped with water and sewerage systems and protected by police and fire departments. The maximum number of men employed at one time was about 4400 who were working at the dam site, on the transmission lines and in various parts of the 95 square mile reservoir.

Courtesy Allis-Chalmers Manufacturing Company

One of the six 33,500-horsepower water wheels being prepared for the new project

THE first consideration in the construction program was the excavation of the overlying alluvial material and gravel above the foundation rock. The general program of construction was to cofferdam the spillway and west abutment areas, which are located on the flood plain of the river at the west side of the valley, and to complete the excavation for this part of the work. The west abutment and spillway were then completely concreted except for notches and sluiceways, the bottoms of which were located at the normal river level to provide for later river diversion.

The excavation for a diversion channel having been carried on simultaneously with the work on the west abutment and spillway portions of the dam, the river was diverted through the temporary notches and sluiceways in the spillway when the concrete in these parts of the structure was completed to sufficient height. The main power station cofferdam, which extended across the original channel of the river, was then closed and unwatered and the erection of the permanent power-house structure begun. With this plan of operation, work could go on without interruption even though a river flow as high as 90,000 cubic feet per second should occur. With the dam complete, the filling of the reservoir could proceed by dropping 80-ton sliding gates in front of the sluiceways through which the river was passing, leaving open only those required to keep a minimum flow in the river below until such times as the reservoir should be full and pass over the spillways or through the passages to the turbines.

Before the filling of the reservoir could proceed, a great deal of work in connection with it had to be accomplished. It was necessary to clear the flooded area of 30,000 acres of trees, 900 miles of fences, and all other floatable material to the satisfaction of the United States Army engineers representing the Federal Power Commission. Before this could be done the high water shore line of the reservoir had to be determined and staked out in order to locate definitely the limits to be cleared. In making these surveys more than 2500 miles of survey lines were run. One town of about 450 inhabitants, a county seat, was below reservoir level and was entirely demolished. Scattered over the 61,000 acres to be flooded was a total of 2850 graves, located in 32 cemeteries and 74 isolated spots. The bodies were removed and reinterred in cemeteries located on higher ground.

IN building the dam, the 551,000 cubic yards of concrete were placed in less than a year. It was all mixed in a battery of four 66-cubic foot concrete mixers which turned out a maximum of 113,000 cubic yards in one month, which is believed to be a record unequaled for work of this kind. In one day when 5082 cubic yards were poured, it was necessary to operate on somewhat less than a 2½ minute schedule continuously during 24 hours, but all mixers were automatically locked to insure a full two minute mixing period after all material had been introduced.

The work on the reservoir and at the dam went forward with such good speed that it was possible to drop the "bear trap" gates across the sluiceways in February of this year in time to store the spring floods. The first wheel went into operation in June and the plant which is now nearing completion will be finished well ahead of the scheduled time.

Mr. Louis H. Egan, President of the Union Electric Light and Power Company and Mr. A. L. Snyder, General Manager of the Osage Project, were in executive charge for the Union Electric Light and Power Company. Stone & Webster Engineering Corporation were the designers and builders.

A gentry crane capable of lifting 150 tons can be placed over any generator to assist in repairs or, if necessary, to remove both generator and water wheel

As a fitting sequel to the article on the telephone in this issue, we have scheduled for a coming issue an article on international radio-telephony.—The Editor.

TO STOP SOIL EROSION LOSSES

SEVERAL years ago the Department of Agriculture began an intensive campaign against soil erosion that promises to save farmers of the country millions of dollars each year. That campaign is now taking definite form in the erosion prevention work of the first regional erosion stations that have been established in widely separated areas, according to Dr. Henry G. Knight, Chief of the Bureau of Chemistry and Soils, who recently returned from an inspection trip to the middle west, northwest, and Pacific Coast states.

The Seventieth Congress appropriated 160,000 dollars for use by the Department of Agriculture in experiments looking to the prevention of the enormous losses of soil and soil fertility in the United States due to rainwash and gullying. The Forest Service and the Bureau of Public Roads are co-operating with the Bureau of Chemistry and Soils in the campaign against erosion. These losses total approximately 200,000,000 dollars annually, according to latest estimates.

MOST of the funds which have become available for erosion work have gone into establishment of regional erosion stations. The first seven of these stations have been located in the red-land regions of Oklahoma and Texas; the gray lands of northern Missouri and southern Iowa; the black lands of central Texas; the light-colored sandy lands of southwest Arkansas, northeastern Louisiana, and east-central Texas; the southern piedmont lands of Virginia, North Carolina, South Carolina, and Georgia; the northern piedmont lands of New Jersey and Pennsylvania; and the dark prairie lands of west-central Kansas.

These stations are established on farms where erosion is a serious regional problem, and are for studying methods of erosion control and of holding on the land more of the rainwater.

Doctor Knight visited the erosion stations at Bethany, Missouri, and at Pullman, Washington, where the necessary equipment has been installed and where sheet erosion or run-off is being measured on experimental plots. Plans for field operations are under way at the station recently established in Page County, Iowa. He found that the farmers are keenly interested in the practical work of the stations, particularly in the terracing of cultivated fields, long a successful erosion-prevention measure in parts of the South but which is new to the western and middle western farmers.

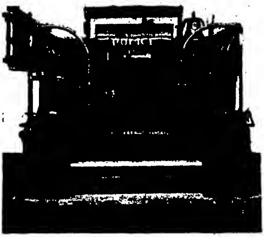
A terrace nearly completed in North Carolina. Following the contours of field, terraces such as this prevent the downhill rush of soil-washing rai

Sheet erosion on a Missouri farm. It has washed the productive top soil from about 50 percent of this farm. Terracing would put a stop to this great loss

Photographs courtesy United States Department of Agriculture

Land erosion of this sort, often seen in the South, can be stopped only by the construction of strong barriers or by the growth of hardy vines and bushes

Above: Emergency Squad No. 2 leaving quarters in charge of a sergeant. The full crew numbers eight. *Right:* Rear of truck showing equipment, including machine gun. Lockers carry tons of equipment



MEETING THE EMERGENCIES OF A GREAT CITY

By ALBERT A. HOPKINS

AN emergency may be defined as "a sudden condition calling for immediate action." The average person is so poorly equipped to cope with an emergency, principally because of lack of training, that policemen and firemen have always been valuable aids in emergencies, big and little. The New York Police Department has a most interesting division which is devoted exclusively to emergency work. In 1925 a truck was purchased and provided with certain emergency appliances and was manned by a sergeant and a picked crew. The usefulness of the idea became so patent to all that there are now 19 elaborate trucks which cost Father Knickerbocker 14,000 dollars each. This service was largely developed through the instrumentality of Police Commissioner Edward P. Mulrooney and Chief Inspector John J. O'Brien.

The squads are located at strategic points in all five of New York's boroughs. During the summer, emergency squads are assigned to both Coney Island and Rockaway Beach, New York's great pleasure resorts. These specialized policemen are carefully selected for this exacting service. The entire personnel consists of one inspector, one deputy inspector, seven lieutenants, 62 sergeants, and 405 patrolmen. Day and night these men await calls through the switchboard that has the most famous telephone number in the world, "Spring 7-3100."

A lieutenant on desk duty in the Emergency Service Division is responsible for the proper and efficient handling of all calls.

Special courses are given in the Police Academy, in an annex to Police Headquarters, so that every man is instructed in first aid, steam boiler troubles, the method of disassembling locks of cells, passenger and freight elevator failures, and traction emergencies (street railway, elevated, and subway). They are also instructed in the hazards encountered with high-tension electric wires and poisonous gases. On the roof of the annex is a gas chamber for demonstration and instruction purposes. This chamber can be filled with lachrymating gases, sulfur, or ammonia fumes and the use of gas masks is here taught. Preference is given to mechanics in the selection of applicants. Practically all the duties previously performed by the Police Reserves have been taken over by this division, releasing thousands of men for police duties. The squads co-operate with the Fire Department in maintaining fire lines and otherwise assisting at fires. In certain districts squads respond to even a first alarm.

BEFORE giving an idea of the calls made upon this division, it might be well to call attention to the truck and the splendid equipment carried thereon. The trucks themselves are of the highest order of workmanship and are driven by a 57-horsepower motor. An inhalator is carried on each side of the driver's seat which accommodates the sergeant and the chauffeur. In the center of the car is a runway flanked by lockers and seats for the squad. Two hundred and fifty-seven units make up the equipment of each truck. Included are 1500 feet of rope, ladders of all kinds, life gun case and canister, cutting torches, jacks, life belts, belly bands for horses, gas masks, acetylene and oxygen tanks, boat hooks, stretchers, axes, sledge hammers, crowbars, grappling hooks and grappling irons, block and fall, shovels, wedges, tools of all kinds, surgical kit, and many other pieces of gear too numerous to mention. There are also the machine gun, two rifles, two shot guns, 2100 rounds of ammunition, tear gas and smoke bombs, and bullet-proof vests.

You may well ask why a humanitarian outfit on wheels like this should be equipped for war. It is all a part of their job. They may be dragging a pond for a drowned boy and an hour later be called to keep order at a communistic meeting or to disperse a crowd. Usually the appearance of the huge green car with its grim-faced policemen

(all in uniform) and two shrieking sirens strikes terror in the hearts of the wrongdoers or those who would like to do wrong. Riots can never assume very large proportions when such truck loads of law-enforcement officers can be transported at top speed from a nearby station house.

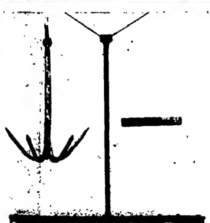
DURING the period of April 1 to December 31, 1930, the various squads answered 2585 calls of every description, from removing a marooned cat from the top of a tree to rescuing persons from gas filled chambers, but the big majority of all these cases might well be termed "errands of mercy." In all, 533 human beings were saved from the effects of gas and drowning, during this period, that otherwise would be now before the "throne of the Almighty," as one of the lieutenants pithily remarked.

Instructions are given in the use of the inhalator, two being carried on every truck. The gases involved are ammonia, carbon-monoxide, chlorine gas, illuminating gas, cyanogen-chloride gas, sulfur-dioxide gas, and smoke fumes. Accidents to vehicles on the roads, from excavations, and from the water totalled 241 cases in the time mentioned. Wrecked airplanes came in for attention in four instances. Overturned boats were righted, persons were rescued from cave-ins and collapsed buildings, and many were released from stalled elevators. Then there was an assortment of explosions to be dealt with and dangerous signs and fallen trees to be removed or roped up. Ten animals were released from trees, 25 horses removed from rivers, excavations, and places where horses should not be; even two escaped steers were captured. It is no fun to be caught in a vault or locked in an empty building on a cold night but the emergency service cares for all. Even the government requisitions the service to destroy stills. This not a type of service, however, whicl relished and it is hoped that some time Uncle Sam may buy a few torches and some acetylene.

One of the lieutenants tells us an interesting story. He had been in the Bronx to help direct the grappling for the bodies of three drowned boys. He returned just as an alarm came in that a brokerage house was being held up in Broad Street. He had just time to swing on to the broad step of "No. 2" as it started its dash downtown.

A member of the squad was assigned to cover an adjacent courtyard. He saw a man climb out a window of the eighth floor and start down a fire escape stairway. The man was carrying a revolver. When he reached the third floor the rifleman took aim and cried "Halt!" The crook was about to take a pot shot at the officer when *crack* went the rifle and the bullet took effect in the

indebted to Inspector Daniel A. Kern and Lieut. M. J. Murphy for assistance in securing pictures



Above: **Candidates for duty in the Emergency Service Division receiving instructions from a member of the Marine Division on the proper way of grappling for bodies.** ***Left:*** **Grappling irons and grappling hooks are vicious looking instruments. The mushroom grappling iron is used for automobiles, et cetera, while the gigantic fish hooks are for human bodies.** ***Upper Right:*** **Pent house of Police Academy converted into a laboratory for demonstrating tear gas bombs and the use of gas masks.** ***Right:*** **Horse overboard; police put on dungarees, haul him out, and then notify the A. S. P. C. A.**

THE BIG NOISE BEHIND THE 'MIKE'*

WHEN out of the night and your loudspeaker comes the screaming whistle of fire apparatus, the rumble of distant thunder, the roar of the wind, the crackling of a fire, the chirp of a canary, the blare of a taxi horn, the heavy drum of a cloudburst, or the sound of waves gently breaking on a sandy beach, you know the genius of N. Ray Kelly, sound technician for the National Broadcasting Company, is at work.

Mr. Kelly has invented and developed many machines for the reproduction of sound effects, and a visit to his penthouse laboratory will soon have you believing that you have been in the yards of a great railroad or that you have just weathered a blustering storm.

The newest of a long list of sound-effect instruments is a simple wooden box, approximately three feet square. It contains a conglomeration of apparatus calculated to reproduce accurately the noises coincident with modern railroad operation. It is called the "one man railroad" and, if all goes well, Kelly expects to have his latest "gadget" on the air during railroad programs within a very short time.

There are scores of sound effect devices in use on NBC programs, most of them invented by Kelly. But this versatile engineer admits that the "one man railroad" intrigues him most of all. It is his brain child, the favorite of a large and successful family.

To capture accurately the chugs, the puffs, the hiss of steam exhausts, the clickety-click of rail heads, the shriek of whistles, the grinding of brakes, the clank of driving rods and other associated rail racket, Kelly spent hours at the Sunnyside, Long Island, yards of the Pennsylvania Railroad. The business of developing realistic sound effects for a nation-wide and critical audience is no haphazard job for this conscientious craftsman. Work, study, and experiment are necessary to success in this very interesting vocation.

While at the Long Island yards Kelly listened raptly to "booster" engines, Pullman cars, gondolas, and other rolling stock. He stored away a knowledge of the conglomerate noises, he memorized the shriek of brakes and the scream of whistles, he timed the puffs of the locomotives and studied the clank of shifting switches. Not one detail of sound escaped his listening ears.

But the "one man railroad" is only one of his developments. He points with pride to sound apparatus that clutters his lofty workshop. With a wave of the hand he will indicate an entire "garage" on a wooden board two feet square, to which are nailed a great variety of automobile horns, including the hair-raising fire department siren. By pressing a few buttons he can reproduce a fleet of taxis, the mad rush of fire apparatus, or the blaring horns of a New York theater-hour traffic tie-up.

The bewildered visitor scarcely has time to take the acq[illegible] of the "garage" before Kelly blandly [illegible] "Gosh, it sounds like a thunder storm outside," and sure enough, whango! goes the roar and rumble of celestial artillery. The visitor has just come in from the sunny, snow-covered streets and the seeming anomolous weather is explained only when Kelly shows him the big "thunder drum," a four-foot frame across which, see illustration below,

Ray Kelly, chief sound effects engineer of the National Broadcasting Company, and a few of the unique instruments which he has designed for producing various sounds for broadcasting

The reverberating roar of a thunder storm crashes from the loudspeaker. In the studio, the sound comes from a tightly stretched square of heavy parchment

*Photographs and text courtesy *Good News*, R. C. A. Radiotron Co., Inc.

heavy parchment is tightly stretched.

Kelly next pulls a cord running through the skin-covered bottom of a pail, giving a very terrifying imitation of a lion's roar; whistles blow in realistic imitation of a dozen different birds; a threshing machine bangs and rattles as a bit of intricate machinery and a baby's rattle are agitated.

Sometimes Kelly conducts his visitor to a vacant studio, arranges a microphone and escorts his guest into the glass windowed monitor room. Returning to the studio microphone, Kelly crumples some stiff paper before the open end of the "mike" and the visitor is surprised to feel himself transported to the side of a crackling fire.

Still standing before the microphone Kelly taps his head with a padded stick and the onlooker is ready to swear he has heard a dog thumping his tail. In fact many people do swear it. We hear rifle or pistol shots. But it is only Kelly striking a padded board with a flat stick, as he explains quite seriously that shell explosions and the actual use of machine guns might completely wreck expensive studio equipment.

The creaking of a porch swing is reproduced by gently rocking back and forth in an old rusty swivel chair placed before the "mike." Animals are heard crashing through the underbrush when Kelly squeezes the straws of a household broom, and the sound of steady rain is produced when excelsior is rubbed against the microphone frame. A torrential downpour is effected by pouring salt on wax paper held before the "mike."

"Many sound effects are obtained by sheer accident," Kelly explains. And to carry out this statement he cites that particular occasion when an announcer stood absentmindedly rubbing his fingers across the teeth of his pocket comb and developed the mournful notes of a tree toad.

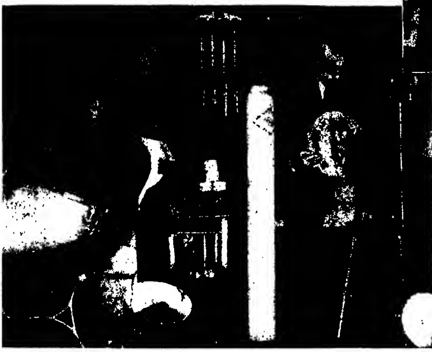
The gentle washing of lazy waves along the ocean front is reproduced by a circular wheel with an eight-inch hollow rim covered by copper screening, inside of which rolls a handful of hard-dried peas.

The wind machine is probably the best known device. It consists of a canvas sheet laid over a paddle wheel winch. As the winch handle is turned the paddles beat against the canvas. At high speed the sound is like that of a howling gale; at low speed, per- [illegible] gentle summer breeze. Winds of all degrees of velocity are reproduced on this machine and storms have been created that have put nature to shame.

KELLY has a broken-down automobile in the NBC laboratory. It is not a real one. It is merely a battered wash boiler filled with assorted junk and equipped with a small electric motor, to the shaft of which are attached several pieces of leather strap. As the motor runs, the boiler is shaken by hand and the leather straps beat against the debris. It really sounds like an antique "horseless carriage" trying to come down the street.

Many modern programs must have their airplanes. Consequently, another use of straps is to reproduce the hum of airplane engines. An electric motor whirls leather straps against drum heads at varying speeds ranging from the slow sputter of warming motors to the high-pitched drone of the take-off.

Ray Kelly declines to estimate the amount of sound effect apparatus operated by NBC, explaining that the tendency is continually to improve the devices and lay aside equipment which has become obsolete.



Above: **A locomotive pulls out of a station; a drum and compressed air tank furnish the sound. *Left:* Straps whirled by a motor strike a drum and simulate an airplane**

Rifles crack and pistols bark, but the sound is from leather pads struck with paddles

THE EARTH BENEATH*

By ERNEST A. HODGSON
The Dominion Observatory Ottawa
Member Scientific Council The Seismological Society of America

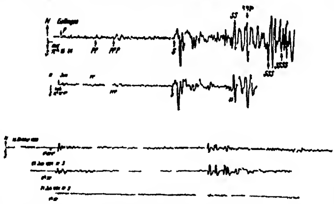
ASTRONOMY first taught us something of our earth as a whole That science was partly responsible for and greatly assisted the voyage of Columbus which demonstrated that one could cross the Atlantic without at least falling *off* The idea that the earth is spherical is now general except in Zion City Illinois Astronomy measures for us the radius of our planet finding it to be about 4000 miles the circumference being nearly 25 000 miles Astronomy mothered geodesy which has demonstrated that the earth is a spheroid

The shape and size of the earth being known mathematical physics also an offspring of astronomy informs us that the average density of the earth is 5 6 (in c g s units) It weighs therefore volume for volume five and six tenths times as much as water This statement may be taken as a convenient cross over to geology Physics and allied sciences are able to tell us only *average* values for conditions within the earth the average density the elasticity as a whole, the mean value of gravity the details are notably lacking The geologist is concerned with surficial details Informed that the earth as a whole weighs a little more than five and a half times as much as an equal volume of water he states that the granite marble limestone dolomite and so on which form the bulk of our surface rocks weigh only about half as much volume for volume as the earth as a whole and that therefore there must be much denser material below The questions throng how far down do the surface rocks extend? what distribution of densities exists within the earth? in what physical state do the materials exist—solid liquid, or gas? We are curious to investigate what lies within the earth beneath'

THE miner has the terse expression "Beyond the pick it is dark' If this be so, how far may we penetrate below the surface? The deepest mine in the world is the Saint John del Rey in Brazil This gold mine was begun in 1834 In 1924 it had reached a depth of 6726 feet The bottom of this mine is not however the point nearest the center of the earth to which man has penetrated The Calumet and Hecla mines in Michigan though only about 6000 feet deep reach a horizon 4600 feet below sea level, said to be the point nearest the center of the earth on which man has been able to tread The South American mines being in the mountains their greater depth of shaft does not penetrate so far below sea level The number of deep mines or deep bores is small their cost is enormous To what depth have you personally inspected the interior of the earth?

If physics deals with generalities geology studies details—but practically only surface details as we have said True time has broken and uptilted parts of the earth's crust exposing at the surface that which must once have lain at considerable depth True also volcanoes bring up materials from below though from what depths these materials come is not so well defined as we could wish The geologist having studied the earth's surface features admits that so far as he can learn the average density of the surface crust is only about half as great as that of the earth as a whole We leave him as he argues from the known to the unknown, from the observed to the conjectured, from the fact that near the surface the temperature increases about 1° Fahrenheit for each 90 feet in depth, to the possibility that at a depth of 40 miles the temperature may be about 2300° Fahrenheit or the white heat of the blacksmith s forge from measures of the elasticity and compressibility of rocks under high pressures in the laboratory to conjectures as to their properties at great depths within the earth We turn to seismology for the decisive tests of any theory as to the structure of the earth

For some an earthquake is a rare phenomenon of passing if for the moment absorbing interest for others it is a dreaded nightmare of horror To the engineer it is a factor in his problems of design to the insurance agent and the financier alike it is a risk to the newspaper man it means business to the geologist it is a tectonic agent to the seismologist it is all of these and more



After Gutenberg [illegible]

Figure 1 Typical seismograms of distant quakes First come the longitudinal or "P waves Later the "S" or transverse waves begin to arrive The "S" waves have greater amplitude

OUR subject requires us to consider the earthquake as a release of energy—the agent which despatches a signal to be registered on the seismograph set up at each of a network of stations distributed over the globe The signals are there recorded after having traversed the earth for various distances and along various paths after having penetrated to various depths The nature of the records indicates the paths by which the signals reached the instrument the properties of the materials through which they passed They are thus worthy of the greatest care in our choice of the network of stations our design of instruments and vaults, our maintenance of continuous recording and accurate timing our thoughtful study

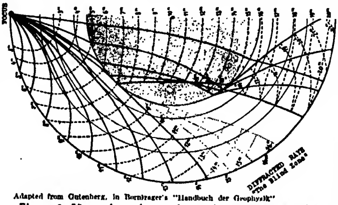
Our first problem may be stated thus At what depth do earthquakes r[illegible] their signals? Some u[illegible]btedly occur on the surface though presumably the causal movements extend deep into the earth Others leave no traces of permanent shift at the surface The added fact that [illegible] are sensibly felt over wide areas indicates that they originate far below We can arrive at a conclusion with regard to depth of focus, as it is called, along different lines of reasoning Dutton used as a means of determining depth a consideration of the rate at which the in

tensity falls off as the disturbance spreads out in all directions from the focus and makes its effects apparent at the surface. He concludes that the maximum depth of focus is of the order of 20 miles. Walker, working with Galitzin's measures of the angle at which the seismic rays emerge from the earth at the different stations in the vicinity of the focus, deduces that the depth of focus is of the order of one-fifth the earth's radius—800 miles! Omori, making use of the duration of the preliminary tremors of earthquake records, deduces that the mean depth of earthquakes in the Kwanto province of Japan is of the order of 21 miles. Gutenberg studied the curve showing the time of arrival of the first tremors and determined for an earthquake in the Schwabian Alps a depth of 34 miles.

A recent paper by Wadati deals very thoroughly with the various methods. He finds that the Japanese earthquakes fall into two groups, which he terms respectively shallow and deep. "The deep earthquakes take place at the depth of more than 300 kilometers (186 miles), while the shallow ones at about 40 kilometers (25 miles)." Gutenberg, in a recent publication, tabulates the values of depth of focus as determined by nine different seismologists for 16 different earthquakes. With the single exception of Wadati's deep earthquakes, the determinations all lie at depths of 28 miles or less. Seismologists generally agree that the data for determining the depth of focus are not as precise as could be desired but that earthquakes probably originate, in general, at depths of 25 miles or less.

THE uncertainty with regard to the depth of focus is due largely to our uncertainty as to the velocity of propagation of the seismic waves in the uppermost layer of the earth's crust. To determine this velocity we must have an earthquake of which we know, accurately, the time of occurrence and the depth of focus. We can be sure of this last requirement only where the depth is zero, that is where the focus is at the surface. On February 18, 1911, a disturbance was registered which was traced to the Pamirs, in central Turkestan. Investigation showed that a great slide had occurred in which from 7 to 10 billion metric tons of rock had fallen a distance of from 400 to 800 yards. The tremors, registered on the seismographs at Ottawa and generally throughout the world, were believed to have been the result of the rock fall. The exact time of the fall could not be determined. Moreover it is now questioned whether the fall was the cause or the result of the earthquake. Such a question could be raised in the case of practically any such earthquake. We fall back upon the velocity of earth tremors generated by an explosion.

The velocity of seismic waves has been studied in the case of a great explosion at Oppau, in the works of the Badische Analin und Sodafabrik in the Bavarian Palatinate on September 21, 1921. The tremors were registered at five seismograph stations ranging in distance from 68 miles to 227 miles. The chord from Oppau to De Bilt—the farthest station· dips only about two miles below the surface at the middle of the arc. We may thus consider the waves as being well within the upper layer of the earth. The exact time of the explosion is known within one second. The records give the velocity of propagation of the most rapid tremors as 5.4 kilometers (3.35 miles) per second.



Adapted from Gutenberg, in Bornträger's "Handbuch der Geophysik"

Figure 2: **How science knows the earth's core is iron: the "blind spot," coupled with the laws of refraction, shows it**

But one swallow does not make a summer. It was desirable to check the value of the velocity by means of other explosion records, especially as the velocity as determined for waves generated by earthquakes of presumably shallow focus was found to be 7.1 kilometers (4.4 miles) per second. Accordingly, in May, 1924, four explosions, the first two of ten metric tons each, of melinite, the second two of five metric tons each, were exploded at La Courtine, in central France. The explosions being predetermined, arrangements were made to have precise timing and fast-speed chronographs, so that the records obtained were spread out sufficiently to be readily legible. The tremors were registered at three stations ranging in distance from three and a half to fifteen and a half miles. The mean value of the determined velocity for the most rapid tremors was found to be 5.5 kilometers (3.4 miles) per second, confirming substantially the results obtained from the records of the Oppau explosion.

This raises a further point. We have referred only to the velocities of the first movement as registered on the seismograph. The fact that high-speed chronographs were used at La Courtine to spread out the record implies that there were other onsets of value. There were.

Waves propagated in an elastic body (that is to say, a substance which has the power of recovering its shape if it is not strained beyond certain limits—and the earth is such a body) are of two kinds. The first is known as a longitudinal or dilatational type and the waves so propagated are called P-waves, since they are the primary or first registered. The other type is called transverse or distortional, the waves being termed S-waves, because they are the secondary registration, in point of time. The P-wave and the S-wave each travel through the earth from the focus to the station, by paths which may be for the present described as being somewhat concave upward, or as sagging below the chordal line joining the focus and the station. The velocity of each depends on the elastic properties of the earth, being greater, in each case, if the elasticity of the material along the path increases, but slowing down for an increase in density. The S-wave has the added important characteristic that *it cannot be propagated through a liquid.*

THE velocity of the first, fast tremor, found to be 5.4 kilometers (3.35 miles) per second in the case of the Oppau explosion, and 5.5 kilometers (3.4 miles) per second, on the average, at La Courtine, was that of the longitudinal vibrations—the so-called P-wave. The velocity of the S-wave was found to be 3.1 kilometers (1.9 miles) per second at Oppau and 2.8 kilometers (1.7 miles) per second in the mean at La Courtine—again a fair agreement. We thus have a measure of the velocity of propagation of the two types of waves in the uppermost layers of the earth's crust, based on observations of five separate explosions, registered at three or more stations in each case. Obviously we wish to add to our observational data of this nature.

To quote from our legal friends, "time is to be the essence" of our experiments. The nearest of the La Courtine stations was three and a half miles from the blast. The first tremor, marking the time of arrival of the P-wave, registered about one second after the explosion. The S-wave required about two seconds to travel the same distance. The difference in time of arrival was thus about one second in the case of the nearest station, and about four seconds

in the case of the farthest. To render the onset of the S-wave legible it was necessary to record the tremors at a higher speed than that generally used for earthquakes. Obviously, if the distance is increased to several hundreds or thousands of miles the difference in time arrival will be increased and, moreover, slight inaccuracies in the determination of the exact instant of arrival of either phase will not greatly affect the velocity determination.

In order to convey some idea of the manner in which the two types of waves make their appearance on a seismogram, the two groups of records of Figure 1 are shown. The arrival of P and S is indicated for the two seismograms of the first group. These are records registered at Jena and Göttingen, respectively—two German stations about 80 miles apart—of an earthquake which occurred at Kansu, China, about 4600 miles from the recording stations. One minute of record line is indicated at the beginning of the record and successive minutes can be seen on the original records as breaks in the line, a few of which are preserved even in the reproduction. The difference in time of arrival of S and P is here about 8 minutes and 50 seconds. To obtain a record such as this a line recording speed of from half an inch to an inch and a half per minute would ordinarily be employed, depending on the seismograph used and the purpose of the registration. Where S and P arrive within a second or so of each other, as in the case of a blast or explosion, it is customary to have a line recording speed of six or seven inches per second. Such a short-distance, but spread out, record would resemble those registered at Göttingen and Jena for the Kansu quake except that the serrations would be more numerous.

THE second group of records is also interesting. It shows the seismograms registered at Jena for three earthquakes, each of which originated in Kamchatka—about 5300 miles distant—in October, 1920, June, 1924, and July, 1924, respectively. This shows how strikingly alike are the records of the same instrument for earthquakes originating at the same epicenter.

We know from long experience that if an earthquake takes place as a sharp, well-defined, single shock, it will be registered at stations which are more than 700 miles and less than 7000 distant in such a manner that the arrival times of P and S can be definitely determined, the difference computed, and the distance from station to epicenter (that point on the surface vertically above the focus) read off from an empirical table or its graph to within 25 or 50 miles. Furthermore, we can, if the stations are equipped with proper apparatus for recording absolute time, determine the time at the epicenter so accurately that the values derived from the records of stations at distances within the above limits will agree within a few seconds. Moreover, the distances from each of three or more stations being known, for any given earthquake, the position of the epicenter can be determined with a surprising degree of accuracy. And, finally, this work has been done, with ever increasing accuracy, by various agencies since 1899, supplementing previous catalogs of felt earthquakes and giving us an analysis of the relative seismicity of the different parts of the earth's surface, which is very good indeed. This analysis is being continuously strengthened to-day by the efforts of over 200 stations, regularly operating seismographs and publishing data. Our time-distance curves are subject to but minor corrections for distances between 700 miles and 7000 miles. We know our seismic areas. The seismic history of many of these areas is already long-continued enough to be of value in various lines of investigation. From this hard-won, but firmly consolidated position we step forward into the front-line trenches, the active sector of seismological research.

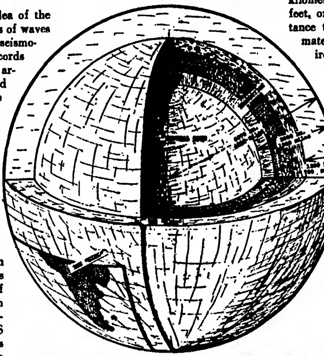


Figure 3: The structure of the earth, exhibiting the series of concentric layers described later in the article

All seismologists agree that the earth has a spherically layered structure, consisting of a central core surrounded by a series of shells of different thickness, each with its own distinct properties. The spherical surfaces separating the various shells are probably fairly well defined, that is to say the transition is relatively sudden. They are referred to as surfaces of discontinuity, or simply as discontinuities.

LET us consider first the central core. The surface of discontinuity surrounding it is believed to lie about 2900 kilometers (1800 miles) beneath our feet, or a little less than half the distance to the center of the earth. The material of the core is believed to be iron, with probably some nickel as well. If our earth is made of the stuff of which other worlds are made (and that seems a reasonable assumption), and if the meteors which occasionally fall to the earth are to be regarded as samples of that material, then we may infer a mixture of iron and nickel for the central core. Here we have a large part of the extra density demanded by the physicist to make up for the light surface rocks and average up the density of the earth to the 5.6 which he demands. The existence of the core is rather well established. The P-waves are refracted into its surface in such a manner that they fail to reach stations which are between 7000 miles and 10,000 miles of the epicenter, leaving the so-called blind zone as shown in Figure 2.

In what state is the iron of the core—solid, liquid, or gas? The question is still an open one. The fact that the S-wave will not be transmitted through a liquid or a gas suggests that we apply that criterion. This is not as easy as might be supposed. Some seismologists believe the S-wave has been identified after transmission through the core. Most are agreed, however, that it has not been positively identified, and some are frankly of the opinion that the central core is liquid or gas. It is supposed to be dense, under high pressure of course, but not an elastic solid. The velocity of the P-wave is high for the layer just outside the central core—about 13 kilometers (8 miles) per second. Within the core it drops suddenly to 8.5 kilometers (5.3 miles) per second. Does the density suddenly increase as you pass into the core, or does the elasticity become markedly less? Always we are left with questions, unanswered as yet but not unanswerable. Of such is the kingdom of research. Without them we should develop an orthodoxy of science which would be fatal.

The surface of discontinuity at the central core is, as has been noted, well-

defined. It is indicated by the "blind zone" and also by the sudden drop in velocity which, in turn, indicates either a sudden increase in density or a rapid falling off in elasticity or a combination of these. The fact that there is a sudden drop in velocity is deduced mathematically from the observational data of earthquake records—the so-called time-distance or travel-time curves. There is no other such well-marked sudden change of velocity with increase in depth as that which occurs at the entrance to the core. The other changes are less abrupt and are, in general, *increases* in velocity. The other discontinuities are thus not so well established, in fact or in position, as is that at about half way down the earth's radius.

ASCENDING from the 2900 kilometer level we traverse, in turn, three layers of slightly different properties, the two discontinuities separating them being so ill-defined that we are not sure where—or even whether—they are. The discontinuity which surrounds the triple layer is at a depth of 1200 kilometers (750 miles). The material composing these three layers is supposed to be silicon impregnated with iron. The iron content is supposed to increase for points successively nearer the core, and to be very small at the outer boundary at the 1200 kilometers discontinuity. The three ill-defined layers, taken together, constitute what is known as the transition layer. The transition layer and the core, taken together, are sometimes known as the "nife" (Ni=nickel; Fe=ferrum=iron).

The next discontinuity is much better marked; its excellence is certain; there is some uncertainty as to its position. It may chance to be different in different parts of the world. Much remains to be done in its investigation. The break is usually held to be at a depth of 60 kilometers (37 miles). It marks the upper boundary of the shell of silicon and magnesium usually designated as the "sima" (the name indicating the constituents). The increase in velocity with depth within this layer is so uniform that it is not believed to suffer any internal discontinuities. The density inevitably increases somewhat with depth due to the superimposed weight; the elasticity must thus gradually increase downward at a fairly uniform rate in the sima, and at a less regular rate in the transitional layer of the nife, until finally we get the great reversal, the fall in velocity, at the central core. Let us come back toward the surface and nearer home. What is the constitution of the upper 60 kilometers (37 miles) of the earth's crust?

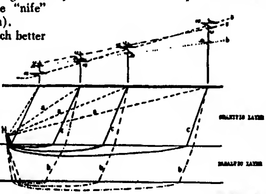
Jeffreys believes that there are three layers, separated by discontinuities at depths of 12 kilometers (7.5 miles) and 37 kilometers (23 miles). These he terms, in order descending, the granitic layer, the basaltic layer, and the ultrabasic layer, thus indicating the probable nature of their constituent rocks. The three taken together are known as the "sial" (Si=silicon; Al=aluminum).

To sum up, then: Beginning at the surface and continuing downward we have, in order—a layer of granitic rock 12 kilometers (7.5 miles) in thickness; 25 kilometers (15.5 miles) thickness of basalt; a 23 kilometer (14 miles) layer of ultrabasic rocks; 1140 kilometers (700 miles) of silicon-magnesium—the sima; a transition layer of silicon impregnated with iron, of a total thickness of 1700 kilometers (1060 miles); and, finally, a great nickel-iron core of radius 3470 kilometers (2150 miles). The best marked discontinuities are those at 60 kilometers and at 2900 kilometers.

Figure 3 shows in schematic form the various layers.

The discontinuities about which we should most like to know more are those at 12 kilometers, 37 kilometers, and 60 kilometers. We shall learn more about them only through a study of earthquake waves and waves generated by explosions. If you look over the edge and into a cup, diagonally so as to just miss seeing a coin placed in the bottom of the cup at the side nearest, and then pour water into the cup, the coin becomes visible, due to the bending of the light ray as it passes from the water into the air—a phenomenon of refraction. The echo is a familiar example, in sound, of the phenomenon of reflection. Earthquake waves are refracted in passing from material of given density and elasticity into a second with different properties, that is, in crossing a discontinuity. They are reflected on reaching the surface or at the inner side of the great discontinuity at 2900 kilometers depth. Seismologists name the various phases appearing on their records according to the paths they have probably taken. For example $\overline{S_cP_c}\ \overline{P_cS}$ represents a wave which began as a transverse vibration, traversed the discontinuity at the core ($_c$); went on as a P-wave but was totally reflected at the inner face of the 2900 kilometer discontinuity; proceeded as P; again traversed the core and completed its journey to the seismograph as a transverse wave. Figure 2 shows some of the waves going directly through the core, refracted but not reflected. These are designated the P' waves. Where reflection takes place, bars above the letters bracket each leg of the path, as indicated in the extended symbol above.

Near the surface we have a multiplicity of refractions. Figure 4 shows some of the paths which have been suggested as possible.



After Gutenberg

Figure 4: **Diagram of the paths of propagation of the longitudinal waves from H, through the upper layers of the earth by several routes**

IT will be seen that we have a very large number of wave arrivals on our seismogram—at least that we may expect many. As a matter of fact some arrive with such small energy content that they register but faintly. This, nevertheless, affords a further check on the theory, as that theory attempts to predict which waves should register thus. The proposed structure may thus be checked in many ways by means of longitudinal and transverse internal or body waves of earthquakes. We have not mentioned that there are also two types, at least, of surface waves. These also serve to throw light on the study of the outer earth shells. Time fails for us to enter on a discussion of what is known as seismic prospecting, by means of which commercial interests probe the upper 4000 feet or so of the earth's crust in the search for oils and minerals. They delineate many of the details of the upper layers, but, from a purely scientific standpoint, the most interesting result is the large mass of data showing the relation of the wave velocity and the type of material traversed.

We have outlined, then, the present theory of the structure of the interior of the earth and indicated the means by which it is to be checked and improved through a study of seismic waves. If a later modification of the theory should give travel-time curves more nearly in accord with later and more accurate data, the modification will be adopted. The present theory is (in the language of the automobile prospectus) the latest model, which we take pleasure in exhibiting at this time. We hope it will find its way into the hands of many and that they may enjoy the fullest service in its use. It may be traded in as soon as suggested improvements have been found worthy of adoption. All may rest assured that *when better theories of the internal structure of the earth are built, seismology will build them.*

STAYING THE HAND OF TIME

By MILTON WRIGHT

THREE thousand six hundred years ago the Emperor Thothmes III, to perpetuate his glory, set up two tall shafts of stone in front of the Temple of the Sun at Heliopolis, carving into the face of them such remarks about himself as these:

"Thothmes III, gracious god, lord of the two countries, giving eternal life, the powerful and glorious bull in Thebes, the Sun's offspring, Thothmes III."

For more than a thousand years those obelisks stood there. Then came the invader, Cambyses, the Persian. He overthrew the carved shafts and plundered the temples. Five hundred years those pillars lay in the sand, partially buried. The desert sand blew against them, cutting away the rock. Moisture from the soil formed crystals of salt in the pores of the stone and year by year forced off particles, impairing the legibility of the hieroglyphs.

Dr. Constantian

Five centuries more passed, and again came the invaders, this time the Romans. Here were real trophies, relics of antiquity, so the masters of the world transported the obelisks to the Harbor of Alexandria to celebrate their conquest of Egypt. There they remained for 2000 years more.

IN 1869, Khedive Ishmail of Egypt offered one of the obelisks to the American Consul, who, in turn, presented it to the City of New York. It was brought to New York and set up in Central Park in 1881. "Cleopatra's Needle" should stand here for ages as it had done across the sea.

But America is not Egypt. There is moisture in the air here that eats its way into any stone and wears it away. Within two years after its erection pieces of rock began to fall from the obelisk. In two more years, a thorough examination showed, there were a great many shells or flakes of large size, besides a multitude of small ones. One flake measured 12 by 18 inches, with a thickness of four inches at the base.

Something had to be done, and done quickly, or there soon would be nothing left of Thothmes' autobiography. All these flakes were mapped and numbered, and then a solid body of hot, melted paraffin wax was applied to fill all voids and prevent any accidental movement.

A few months ago the obelisk was examined carefully by experts. After 45 years no indication could be found of any additional crack or flake or of the enlarging of an existing one. The preservative had stopped completely the rapid disintegration of the oldest monument in America. The hand of time had been stayed.

But what of other structures in America? Do they, too, not wear away in time? And would not the same treatment applied to the Obelisk preserve them? They do deteriorate, and the same treatment is applied to prevent it. Certain sections of the Cathedral of St. John the Divine, the New York City Hall, the palatial residence of F. W. Woolworth, Fraunces Tavern, the Graduate School at Princeton, Plymouth Rock, and innumerable other piles of stone or brick have been treated by the same process. And nearly all of this work that has been done in the last 20 years has been done under the direction of one man—Dr. Raphael Constantian, doctor of monuments.

Dr. Constantian, a native of Armenia, began his career as a Doctor of Medicine, having obtained his degree at Edinburgh. Upon his graduation he went to Constantinople, but Constantinople just then was no place for Armenians. It was in August, 1896, that he arrived, just in time for the massacres in the reign of Abdul the Damned that shocked the conscience of the world. Young Constantian was thrown into prison, at length being escorted to a French ship by the British Consul and sent to America. He began to practice medicine in the Bronx, but New York was full of young doctors, and, to put it mildly, the Edinburgh-trained Armenian was not making his fortune. Then began a series of chance happenings which changed the significance of his title of M.D. and started him on one of the most unusual and interesting professions in the world.

"I HAD gone down to the Bible House to meet a friend of mine, the editor of the *Christian Herald*," he told us. "As I arrived another man was just leaving, and I was introduced to him. It was Edward M. Caffall, son of Robert Caffall, inventor of the paraffin waterproofing process. I asked:

"'Can I do anything for you?'

"'You certainly can,' he replied. Then he told me about the process his father had originated and about his own desire to make a going business of it. He had no money and neither had I, but in half an hour we had arrived at an understanding. In three months I had organized a company, and in eight months we paid a dividend. If I had been 30 seconds later in calling on my editor friend, however, I never would have met Caffall. This was in 1909."

"Cleopatra's Needle," Central Park, N. Y.

"But how did Caffall's father come to originate the process?" we asked.

"Robert Caffall was Queen Victoria's gardener," he replied, "but was a man who was interested in many things. Paraffin wax was a new product in 1868. He had a piece of it that came from the United States and he heated a brick and waterproofed it with the wax. Then he waterproofed a hop kiln, and then a church.

"But Caffall was interested in bigger things than waterproofing buildings. He came to Amer-

ica with the idea of cutting a canal across Florida, but in spite of his urging the Florida Legislature refused to appropriate the necessary funds. From time to time he waterproofed buildings but it was only incidental with him. One of his jobs was Cleopatra's Needle. After he died, his sons occasionally did some waterproofing work, but had never made a really successful business of it."

"How did you get your first job?" we inquired.

"Chance had a lot to do with it," he replied. "I had gone down to the Customs House on a matter involving taxes and was looking for the proper office to enter, when a young man passing through the hall, asked:

"'Can I help you?' They were the same words I had used upon meeting Mr. Caffall, although the significance of them did not strike me at the time. We got into conversation and the stranger became interested in the waterproofing idea. He was Cornelius Wickersham, son of George W. Wickersham, who was then Attorney General, and he was just starting out to practice law. He became our counsel.

"'I know an architect named Cass Gilbert,' said my new friend. 'How would you like to meet him?' Cass Gilbert was one of the foremost architects in the country; there was nobody whose acquaintance I would rather have made, so we went to Gilbert's office. The card of my new attorney was an open sesame, and in almost no time we were telling the great architect all about it.

"'NOW this is a coincidence,' he said. 'I have planned the Ives Memorial Library at New Haven, a red brick structure with marble trim, and only recently Mr. Watrous said to me with emphasis, "Remember, Mr. Gilbert, no salts on this building." I assured him there would be no salts, but, frankly, I didn't know how to prevent them. Now, will your process prevent those salts?'

"The salts to which he referred are alkaline salts dissolved by rain water and left by evaporation. You have often seen them on a brick wall. They are an evidence of dampness. Not only are they unsightly, but they break down the surface of the wall. They are precisely the thing our waterproofing process would prevent, and so we assured Mr. Gilbert. We came away with a 2500-dollar contract. Incidentally, years later, the success of that job led to our treating the Peabody Museum at Yale. One job followed another and gradually the business developed."

"Is the process the same as it was in the beginning?"

"Essentially it is, although we have developed it considerably. For example, we have developed the idea of heating slowly to get a deep penetration—we can force the wax all the way through to the other side, if we want to—and we have developed, also, a special cleansing process to get rid of every evidence of waterproofing."

"What evidence?"

"Wax softens and catches dirt. This darkens the building. By saponifying the surface and dissolving this surface wax away, with the aid of steel brushes, we restore the stone or brick to its original color."

"Just what does the entire process consist of?"

"First the surface must be put in first class condition. Every soft brick must come out. If there is a crack in a brick it must be cut out. Neat, tight joints must be made. Because of changes in temperature, you know, the face of soft brick will fall off in time. In one school building on Long Island we had to replace 7000 to 8000 bricks—practically rebuild the whole wall. The building had been erected in wartime and a lot of bad bricks had been used. Some of the bricks you could carve with a penknife.

"STONE, especially laminated schist with a lot of mica, breaks down easily. Bad stones must be replaced. Then every joint must be tested to see if it is hollow, and if it is, it must be cut out.

"The wall thus properly prepared, we heat the wall a square yard at a time, using charcoal stoves, and while the

If the wall is bad, new bricks must be inserted before waterproofing

wall is hot and dry the wax compound is heated to a liquid and applied with a brush. It works its way in by capillary attraction to the end of the hole and hardens gradually as the wall cools. Much depends on the skill of the workman, and he must use care and apply his heat and his liquid wax slowly."

"But why is heat necessary?"

"Practically every masonry wall exposed to the weather contains a considerable amount of moisture, and it has been found that the walls of many buildings have not dried after long

The crumbling sandstone was cut away where necessary, the stones waterproofed

periods of years. As it is quite impossible to secure penetration of a water repellant mixture into a damp body, heat is employed to eliminate the moisture from the wall. tl
a deep penetration
pound."

"Isn't the deterioration of a building a sign that either the architect or the builder is at fault?"

"Not at all; the penetration of water into building materials is a natural process that can be prevented only by rendering the surface permanently waterproof."

"Well, would you recommend that all stone or brick buildings be waterproofed?"

"No, I wouldn't go so far as that. I do say, though, that the vulnerable parts of the outside of a building should be taken care of. The most vulnerable are the parapets; they get the effect of the weather from the top as well as the two sides and they are the first to suffer. Sometimes architects specify waterproofing for the sides which face prevailing storms—in New York these are the north and east."

"And how long does waterproofing last?"

"We guarantee it for ten years, but unless there are unusual conditions of some kind, it should last as long as the building."

AND NOW, IT'S SEAWEED

Kelp from the Pacific Coast May Supply Elements Which Are Now Lacking in Our Diet

By HELEN R. CRANE and EMORY W. THURSTON

SEAWEED has had its ups and downs, dietetically speaking. If, at the present moment it appears to be entering upon the period of its greatest upward curve of popularity this is not because of any newly acquired needs in man, but merely that his attention has been once more attracted to his food.

Today man has turned over the details of his everlasting search for food to business houses. These organizations are not generally interested in diet as such, but only in their particular viewpoint of it and, therefore, long-suffering man, in his preoccupation, has foisted upon him a regimen poorly adapted to his requirements. His meals lack balance and in consequence he suffers from deficiency diseases.

Primitive man ate his whole prey, not just the sirloin steaks. He managed his own larder, and economic pressure as well as instinct bade him discriminate against no part of the animal he brought in. In this way it came about that his diet was likely to be well balanced. Especially was this true if he lived near the sea.

SHORE dwellers seem always to have used various algæ to supplement their diet, in the same manner that the California Indians did. When the white men came to their country these Indians were living in a stone age civilization. Their skeletons show them to have been remarkably free from deficiency diseases and an examination of hundreds of skulls excavated by the curator of the State Museum discloses not more than two or three decayed teeth. Moreover there is no evidence that goiter was ever known among them.

Modern scientists became interested some time ago in the fact that there was a noticeable absence of the deficiency diseases everywhere in the world where sea plants are used for food—Japan, China, Ireland, and all along the northern seas. Interesting himself in a study of this subject, one of the prominent experts on live-stock feeding went to Europe. He was looking for an answer to the problems facing stock-men in certain sections of the United States—diseases, still-births, difficulty in raising the young—and he wanted to study conditions over there.

Above: Bargeload of kelp just being docked. The serrated mowing-machine cutter bar and elevator are shown raised out of the water. *Below:* Unloading wet kelp from a barge

He learned among other things that the peasants of some of the countries bordering on the seas were in the habit of gathering the sea mosses, drying them in the sun, and then adding them to the cattle's feed. Wherever that was done he observed strong, healthy live-stock. It was a practice worth following up.

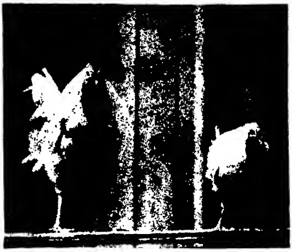
Still with no thought of human dietary needs he returned from Europe and began a search for seaweed that could be fed to animals. The Atlantic coast offered nothing that was practical but on the Pacific coast he found some beds of kelp which had been used during the World War by the Government as a source of potash, iodine, and acetone. They were *Macrocystis pyrifera* "groves" and they extended 200 miles along the coast of southern California.

EXHAUSTIVE experiments followed. Well known chemists were called in and a means of dehydrating the plant was devised—a means that would preserve elements, vitamins and chlorophyl. When concentrates had been prepared they were given to selected herds of cattle that had been experiencing all kinds of illnesses—that is, the concentrates were added to their daily rations. Within two months their difficulties had practically disappeared.

Experiments followed on other herds, with the same results. The outcome has been that many tons of the product are supplied every week to live-stock breeders in all parts of the country.

Now comes the story of kelp's serious introduction into the human dietary of this country. As mentioned before, there probably never was a time when it did not serve as human food, but 20th Century civilization has led people far from some of their old food habits. Having introduced kelp to the live-stock with satisfactory results, its promoters began to think of using it for humans, and so a series of white rats from the laboratories of the California State University was called upon to test its efficacy.

After two years' careful work with rats, men and women in widely separated areas were selected to test the seaweed, now ground into a fine powder and not unpleasant to the taste. They were individuals suffering from all kinds of diseases. They took the kelp regularly for several months and while there were instances where no apparent results were experienced, benefit in most cases was notable. Every one of the patients who had been suffering from deficiency diseases was benefited to a degree almost unbelievable unless one understands the composition of *Macrocystis pyrifera*.

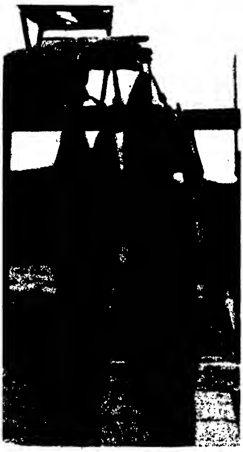


Two roosters, same age, raised on same diet except that one received a ten percent addition of kelp

Analyses of kelp were made by Government chemists from the Department of Agriculture, as well as by chemists in several of the leading universities. The presence of 32 of the chemical elements has already been demonstrated in it and Professor George W. Cavanaugh, head of the Department of Agricultural Chemistry of Cornell, who has spent the past six months studying the plant and its value as a food, states that he is of the opinion that he may find many more of the known elements in it. He also expects to find them in sea water, by the way. The [illegible]s appear to exist in the plant tissues in a complex colloidal combination with chlorophyl and the precious vitamins A, B, D, E, and probably F and G.

Biologists are fairly well agreed that, in most circumstances, the animal cell cannot accept inorganic minerals and convert them into organic ones that form the basis of protoplasm, but this function can be performed by the plant kingdom. It is in the tiny laboratories, the chloroplasts, that the actinic rays of the sun accomplish the miracle of the photosynthesis—there that the inorganic becomes organic and that the protoplasm of the animal world is built.

Now, a plant is only as rich in minerals as the medium in which it grows, and many areas of the earth have for thousands of years been starving their plants. Ever since the day of the first rainfall, the earth has been undergoing a process of leaching. It is not difficult to imagine the floor of the ocean as being uniform in its chemical character before parts of it were elevated above the surface. Sea water is still uniform in quality except where it is locally modified by fresh water intake, or by some other local influence. When the land first appeared it was rich in minerals and could support a giant flora and animal world, but gradually, as the epochs passed and every rainfall washed more and more of the elements out of the land and back down into the sea, the forms perforce diminished. It would appear likewise that, while some of the forms of the sea have diminished for one reason or another, many of them have maintained their pristine proportions, and today the largest forms in the animal and vegetable kingdoms are to be found there. The *Macrocystis pyrifera* is one of the largest plants in existence.

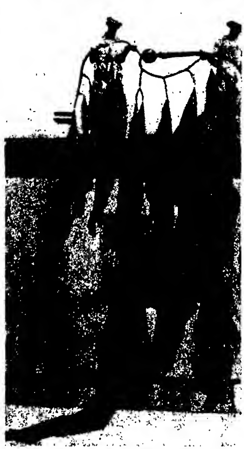


Kelp leaves with the little "floaters" which keep the plant upright in water

The Macrocystis groves lie about 30 miles offshore, far enough from the harbors to escape contamination. Strong currents, so essential to their being, wash them about vigorously while the sun plays upon them approximately ten months of the year. A rocky ocean floor is their choice of a home site. They have no roots, but fasten themselves to the rocks with huge holdfasts sometimes two feet in diameter. Then they start upward toward the sun. Their average length is between 50 and 60 feet, and because of their rapid growth they can be cut every year, the tops being mowed somewhat as one mows a lawn.

Man is again coming to the realization that back in the sea, his original cupboard—the cupboard that served so well in the earliest days of his ancestors' being—lies some of the food he still needs; that a few of his physical requirements have not changed so much after all since his "amœba" days: in other words, that protoplasm is protoplasm, and is still the first consideration of mortal existence.

Is seaweed to become a part of the national diet?



Fronds of giant kelp. The two men who are holding them give a scale of size

Panel type dial tandem office in New York City, designed for handling calls from manual offices and suburban toll traffic in areas where a large proportion of the central offices are of the dial system

PROGRESS AND THE TELEPHONE

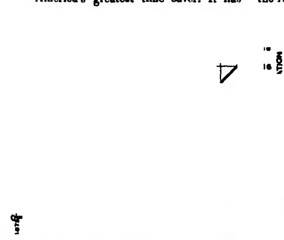
By F. D. McHUGH

HAD man not learned to communicate his thoughts, ideas, and knowledge to others of his kind, his superiority over the lower animals would be slight indeed; his reasoning power by which his superiority is usually measured would count for little. In the measure to which it has been utilized, therefore, the telephone has had a tremendous influence in shaping our modern day civilization, in speeding up business, and assisting our progress. If that influence has not been exactly cultural, it has at least been of so highly practical a nature as to contribute to the raising of our standards of living; it has helped to promote the progress that has given us greater advantages culturally than we ever possessed before the age of the telephone.

Since man first began to utter intelligible sounds, he has felt the need of methods of sending his messages to distant points and of disseminating widely his ideas for the edification or information of others. He has progressed through the communication eras of drum, fire, smoke, and courier methods to the telegraph, the telephone, and the promise of a television method. Coming after the telegraph, the telephone has surpassed it; and television, when it is made commercially practicable, would appear to be an adjunct rather than a competitor of voice communication.

Telephony, then, with both wire and radio mediums at its command, represents our most efficient means of fast communication and the degree to which it is used in various countries should be, to a certain extent, a fair index of national character. This does not mean that, in having over 20 million telephones—57 percent of all those in the world—the United States possesses a spirit of progress more clearly designed to assure leadership in commerce than does that of other countries; some of our critics say that we haven't yet found that formula. It does mean, however, that Americans have learned the tremendous importance of time-saving and its bearing on progress.

The telephone has indeed become America's greatest time saver. It has come to be almost as important to us as speech itself; and the company which operates it in the United States is one of the greatest corporations in the world. In 1930, the year of the world's worst depression, the assets of the Bell System increased to more than five billion dollars. Almost as bewildering are the figures which show that, for the year ending December 31, 1930, the gross income of the telephone system amounted to 1,103,939,805 dollars. This puts the Bell System at the top of the world's list of larger organizations, private, state, or corporate. The German State Railways, the second on that list, is, however, larger in point of total assets.



The significant rise year by year in the number of telephones in use in the United States since 1875

The report of the parent company, the American Telephone and Telegraph Company, shows a net incor for 1930 of 165,544,707 dollars after depreciation, interest, federal taxes, and so forth, had been deducted. This represents $10.44 a share on an average of 15,856,696 shares outstanding during the year, and $9.22 a share on 17,956,512 shares actually outstanding at the close of the year. In passing, it might be remarked that a large percentage of these shares are held by small investors and an organization of this nature is therefore superior in one vital respect to the so-called Communistic system which is tempting to function in Russia:

it actually works for the benefit of the greatest number.

The average number of shares held by a stockholder, of whom there are 580,000, is 31, and no single holding amounts to as much as 1 percent of the total capital stock. Concerning this fact, the company states its policy thus: "The fact that the ownership is so widespread and diffused imposes an unusual obligation on the management to see to it that the savings of these hundreds of thousands of people are secure and remain so." This policy quite naturally imposes, in turn, the further obligation to see to it that at all times the service is adequate, dependable, and satisfactory to the user; or, in other words, to meet both obligations the service given must be the best possible at the lowest cost consistent with financial safety.

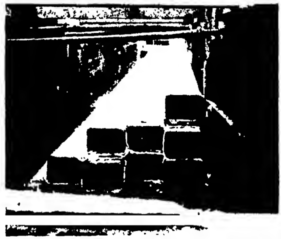
WALTER S. GIFFORD, president of the company, said in his annual report that "the depression which affected business in general in 1930, inevitably affected the telephone business, but not in a way or to an extent to disturb the fundamental objective of the Bell System. It has been able to improve and to extend telephone service. . . . Confident of the continued economic growth of the country and the even more rapid growth of the telephone business, more than 15 million dollars—which is somewhat in excess of any previous year—was spent for development and research for future improvements."

What this monster corporation that can spend such a sum on research alone, is, can be told in a few words. It is a company composed of 24 closely associated Bell Telephone Operating Companies which own and operate 15,649,000 telephones covering the entire area of the United States, and the telephone lines used for toll service within their territories. These companies also have operating agreements providing for interconnection of lines with several thousand independent companies that own 4,404,000 telephones in this country. Besides this "single unit system" operation of 20 million telephones, there are 101,000 telephones not connected with the Bell System.

Some of the 24 Bell Operating Companies are subdivided into smaller autonomous operating units. For long distance calls between the territories of different operating companies, service is supplied by the Long Lines Department of the American Telephone and Telegraph Company, in close co-operation, however, with the associated companies.

In the general departments of the A. T. & T. Co., which includes the Bell Telephone Laboratories, there are 7500 scientists, engineers, business experts, and assistants whose duty it is to improve equipment, and develop new methods and facilities for more efficient service. New types of telephone plants, and operating, maintenance, and business methods are standardized by the general departments and adopted by the associated companies to the extent that they apply to local conditions. Materials and apparatus, after being standardized by the Bell Telephone Laboratories are supplied by the Western Electric Company, Inc., a company owned by the A. T. & T. Co., which manufactures them or purchases them, as the case may be, in quantities that insure large economies.

This, then, is the organization that renders telephone service to the nation; which enabled nearly 22 billion local voice messages to be made last year: and which could spend a total of 15,000,000 dollars for research—progress insurance—in 1930, and 585,000,000 dollars for additions, betterments, and replacements in the same period.


Typical underground cable run ducts showing materials used and the method of construction

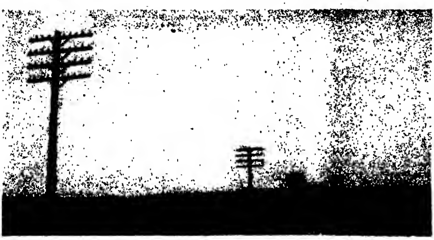
A word might be said here about the faithful young women who constitute an important part of this system: the operators who do their best to serve us whether we speak good English or a language of grunts, gulps, and profanity. In 1930, the Bell System employed an average operating force of 119,000 young women for local calls and approximately 40,000 at the toll boards. These young women are very carefully trained, and most often when we complain of the service, the fault is our own.

The belief is rather general that the dial telephones which are now being installed by the hundreds of thousands all over the country are throwing many of these operators out of work, that the number of operators required when the dial 'phones are in operation will be much less than at present. Such is not the case. Experience to date with dial 'phones has shown that it is actually necessary to increase the number employed. Furthermore, with this modern system, the operator must be able to take care of an infinite variety of requests from the user who dials "operator." She must supply any kind of information at a moment's notice, make connections for toll and other special calls, and assist in the general operation of the system. When conversion to the dial system began in 1921, there were 128,000 operators but in 1930, with approximately one third of the telephones dial-equipped, there were about 159,000 operators.

Making the change from manually operated instruments to the dial system is a job of the first magnitude and will not be completed for a good many years to come. During 1930, the change was effected on 800,000 telephones, bringing the total of dial telephones to approximately 5,000,000 or about one third of the total owned by the Bell Syster

Particular attention has always been given to the apparatus installed on


Cross-country aerial toll cables of this type now stretch for hundreds of miles over the United States and many thousand miles of extensions are planned



Open wire pole line construction of a type that is familiar to the entire country. Much research was necessary to allow the increase in number of wires carried

the subscriber's premises for after all, that is one of the most important parts of the entire system. Recognizing this, the Bell Laboratories have worked and are still working strenuously to improve the transmitter and the receiver, two fundamentally important elements of this apparatus. The efficiency of these parts has been greatly increased so that now the transmitter acts as a high-ratio amplifier of the voice and the receiver reproduces very faithfully the voice from the other end of the wire.

PASSING over other details of the telephone plant such as installation of new equipment, cables, lines, and so forth, maintenance and extensions, we come to the subject of toll service or, as it is more generally known, long distance service. Toll service is a term designating service between two telephones not in the same local exchange area. An outstanding feature of the operation of the telephone system during recent years has been the rapid growth of this service. Company figures indicate that during the last five years, the number of completed toll messages has increased by 67 percent. In the same period, the number of telephones has increased by 28 percent. From these figures it will be noted that the number of toll messages is increasing at a more rapid rate than is the number of telephones; in other words the number of toll messages *per telephone* has increased by 30 percent.

Those of us who have occasion to make long distance calls now and then must admit that one obvious reason for this increase is the material improvement in the service. This applies not only to the greater speed in getting our calls through, but also to the improved clarity of the human voice as it is brought to us over thousands of miles. Here again the company records prove illuminating. In 1920, the average time required to put through a toll call, from the time the call is placed to the time the person called makes a response or the operator gives a report, was seven minutes. A sharp drop to 4½ minutes was made in this time-lapse in 1921; and from that time on there was a steady speeding up of service until, in 1930, the time required was one minute.

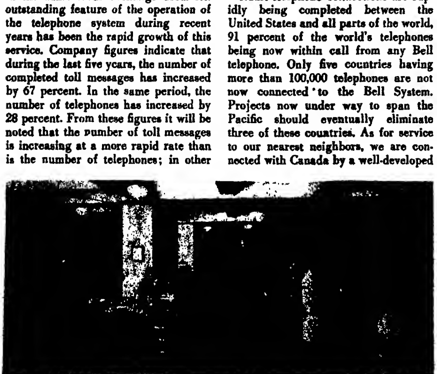
Radio-telephone connections are rapidly being completed between the United States and all parts of the world, 91 percent of the world's telephones being now within call from any Bell telephone. Only five countries having more than 100,000 telephones are not now connected to the Bell System. Projects now under way to span the Pacific should eventually eliminate three of these countries. As for service to our nearest neighbors, we are connected with Canada by a well-developed arrangement of lines; and have been connected with Mexico since 1927.

The special services of the American Telephone and Telegraph Company include telegraph service, operation of telephone lines for private use, arrangement of telephone networks for radio broadcasting programs, telephony in connection with aircraft operation, ship-to-shore telephony, operation of teletypewriter systems, and telephone services for railroads. On over 60 percent of the total railway mileage, the train dispatching is now done by telephone.

Bell engineers have also done intensive development work in the field of television and have made much progress, as is attested by a demonstration given at the Bell Laboratories some months ago. At that time the writer sat in a booth and held a two-way conversation with a friend in a similar booth at the company's main office at 195 Broadway, New York, three miles distant. In each booth the image of the speaker at the other end of the line—the distant station—was reproduced in miniature with great fidelity. In this demonstration which gave a promise of extremely important developments yet to come, 5 special telephone circuits were used to carry the electrical impulses which reproduced the voices and the images.

COMPANY research in connection with the faithful recording and reproduction of sound has led to certain "by-products" such as the improvement of phonographs and their records. The Orthophonic Victrola is an example of such development and an extension of this development produced the talking motion picture. Sound research has also led to the development, in close co-operation with members of the medical profession, of devices of value to persons having abnormal hearing or speech. Important by-products of this nature are: the audiometer, which is useful in determining the "hearing ability" of individuals; and the artificial larynx which makes speech possible for those who have lost their natural larynx due to pathological conditions. Other by-products of interest to the medical profession include the electrical stethoscope and the electro-cardiograph.

In summing up, it may be said that the telephone has come to be one of the outstanding symbols of the modern age. Business and industry could no more function without it—properly and at their present tempo—than they could function without the swift carriers of commerce. With the telephone already closely co-ordinated with industry and trade, the company anticipates the demand for services and is looking forward to a more rapid growth of telephone usage in the United States than ever before.



A private branch exchange which takes care of 1600 stations. Through it incoming calls are distributed and various extensions may call each other

A BOOK-PRINT READER FOR THE BLIND

By ROBERT E. NAUMBURG*

ALTHOUGH it is more than 100 years since the invention of the dot system of raised printing for the blind by the Frenchman, Louis Braille, less than one book in a thousand has been put into embossed type, and there is no probability of embossed type books ever catching up with the quantity of books printed in ink. The limiting factor in the Braille system is the enormously increased size of any ordinary book "translated" into Braille. Due to this, attempts have been made to work out methods by which the blind may read type-printed books. My invention, the Printing Visagraph, is the result of much intensive development work to this end.

The purpose of the Printing Visagraph is to allow a blind person to sit n his home or in a public library and read any book available to those with sight. This machine takes the place of the human eye and it must, therefore, have mechanical or electrical eyes of its own. Either a selenium cell or a photo-electric cell may be used.

A STRAIGHT filament lamp throws a fine beam of light radially on a scanning disk and illuminates six concentric rows of holes. The six beams of light pass, in a vertical row, through lenses onto the pages of the book to be read. All six beams are reflected to a single cell which is close to the book but out of the way of the direct beams of light.

The six spots of light set up currents of six frequencies which are then amplified and filtered through a radio filter. Each of the filtered frequencies goes to one of the six magnets in the printer. Each magnet controls a printing point.

When the point of light falls on white paper and is reflected onto the cell, current flows and one magnet pulls down its armature, keeping the printing point away from the aluminum foil. When the point of light falls on black printing, there is no reflection of light to the cell and therefore no current flows in the magnet. A spring then pulls the printing point upward to make an indentation in the aluminum foil from below, which may be felt or seen from above.

There are two main parts to the Printing Visagraph. The lighthouse or optical or scanning system is at the left of the reader, and the printer or reproducing system is at the reader's right. The ordinary printed book is open, face up, under a plate of glass under the scanning system. The lighthouse travels from left to right, over each line of the printed page, very much as the human eye would do. At the same time the printer travels from left to right under the roll of aluminum foil, but with a magnified motion in order to make larger letters that may be felt. Like the human eye also, the scanning system returns to the left margin quickly, and does no reading on the return stroke.

The foil used is of pure sheet aluminum, with grooves running both vertically and horizontally, forming a fine screen-like pattern. These fine walls of metal ι

metal to "flow" freely without being torn by the embossing point. After the machine has formed the raised letters on the foil, the sheets may be preserved by applying shellac or other material to the back, or the impressions may be erased by squeezing the aluminum through a pair of rollers.

A handle at the left side of the reader allows him to space the book from line to line and feed the aluminum foil from its roll. The line spacer is variable and may be set once for each book.

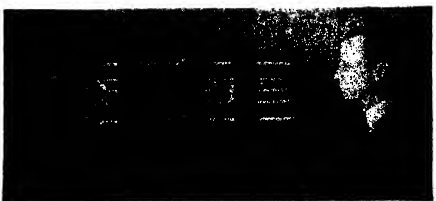
The scanning points are made to fit the size of the type by adjusting a lens. This is also done once for each book.

The height of the letters on the aluminum foil does not vary with changes in type in the printed book, because the magnets and printing points are spaced a certain distance apart and do ı ary. The height of a letter is about the ıt of Braille letters for which the finger of most blind persons has lready been trained. Indeed, expeıce has shown that blind persons ıiliar with Braille can learn to read new type of embossed letters in a weeks' time.

The Printing Visagraph opens up to lind people a world of literature, both sic and current, hitherto hidden n them except when friends read to

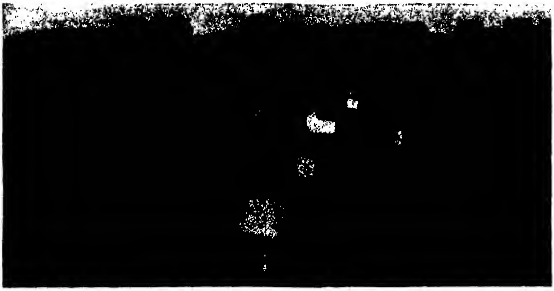
At the left of the blind reader are the book, printed in ink, and the scanning system. At her right is the roll of aluminum foil. Standing behind the machine is the inventor, Mr. Naumburg

The exact size and arrangement of the on foil by the new machine



Demonstrating the manner in which the points of light scan the printed letters. This demonstrator has only five points; the machine itself now has six points

*Mr. Naumburg's address is 40 Meadow Way, Cambridge, Massachusetts.



Casings in place in a highway fill, ready for lowering of dynamite

BLASTING ROADS TO SETTLE THEM

MODERN traffic demands have made necessary the accelerated fill settlement methods in highway construction. Today, highways are mostly built or re-located on straight lines between points, a fact that very often makes it necessary to cross swamps and other soft stretches.

As implied by the name, the purpose is to accelerate by the unstinted use of explosives the settlement of "fill" material in construction work. At present the method and its variations are used in connection with highway construction across swamps, drained lakes and ponds, marshes, bottom lands, and other soft and unstable areas.

The method, however, is applicable also to railroad building and to making solid earth foundations for wharves, factory sites, parks, and any other operation on marshy lands. Also, it would seem to offer possibilities where quicksand is encountered, provided, of course, that solid bottom exists at not too great a depth.

IT opens a relatively new and rather important field for explosives in construction. It further emphasizes the value of explosives as time savers. Furthermore, it presents new opportunities for the application of engineering principles, research, and experimentation.

According to a report of a committee of the American Road Builders Association, "... swamps, marshes, and peat bogs represent the most treacherous areas over which modern highway embankments are constructed."

In a general description, Larry F. Livingston, of the du Pont Company, says: "The use of explosives is particularly successful in displacing underlying unstable material and in compacting filled embankments in such areas.

"There are two distinct methods of doing this type of work. In general: one is to blast as large a ditch as possible along the center line of the projected highway. Such a ditch may be 30 feet wide and eight feet deep. Then fill in this ditch and pile up a sufficient quantity of material to cause a considerable natural settlement, due to the weight of the fill.

"The second method is to place the required fill on top of the marsh and load the dynamite in the mud or muck underneath the fill material. The force of the explosion pushes the muck to the sides and the fill settles into place because the lateral resistance of the muck and semi-liquid mud of marsh or swamp is far less than the pressure of the great weight of earth fill piled along a highway right of way.

"Because of the diversity of factors involved and conditions encountered, many variations and combinations of the two methods are used."

Alfred Mathewson, of the du Pont Company, states: "The first fill settlement blasting of which there seems to be any authentic record was done in Minnesota in 1926, by the highway engineers of that state who conceived the idea that blasting in the muck below fill material would accelerate settle-

Boxes of dynamite arranged on a "three point" system of loading, before depositing fill material on right of way. See bottom diagram on opposite page

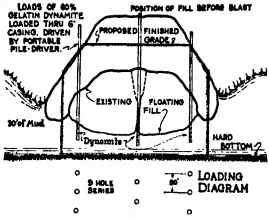
ment." The results obtained were good.

The plan of blasting a ditch along the center line of a proposed highway (referred to above) is an application to fill settlement operations of the cross-section method of blasting wide ditches or other excavations, which was developed by Mr. Mathewson.

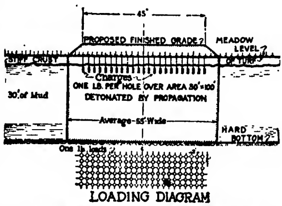
Cross-section blasting is applicable where soil, peat, or other substance is sufficiently firm to maintain ditch bank lines long enough to permit the piling of earth, sand, or other fill material along the highway center line.

Accelerating the settlement of road fills has been developed to an extent that permits the building of highways over soft and unstable areas and with so solid a foundation that permanent concrete slabs may be laid within a few months or a year of the filling operation. Formerly, without the use of explosives to facilitate settlement, it sometimes required as much as five to ten years of gradual, natural settling and adding of fill material. Even then the surface might develop uneven spots and a good road could be maintained only at high cost.

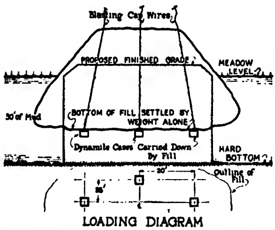
Owing to the depth of muck or mud, it sometimes is necessary to fill to a depth of many feet. Filling is being done to depths of 20 to 50 feet and even as much as 90 feet to reach solid bottom.



Cross-section of the highway at top of opposite page showing method of loading dynamite



The propagated method of breaking up and "liquefying" a stiff earth crust before filling



When the dynamite beneath the heavy fill is detonated, the muck mushrooms out at the side

Banks of fill material, usually earth, are built up to considerable heights before sub-surface shooting of dynamite is done. For the greater depths, subsequent filling and blasting are done. Not infrequently, the piles of fill are 20 to 30 feet high and ramps are built up to permit dumping from trucks. This material settles considerably after the blasting, and soon settles to its predetermined level.

One of the methods of loading consists of placing boxes of explosives at designated points on the road line in a wedge, or triangular, system with one case ahead on the center line, across a marsh or swamp and dumping fill material on top of the cases. A cartridge in each box is primed with an electric blasting cap and wires are attached to carry current from an electric blasting machine for detonating the charge. A heavy iron wire is tied to each case of explosives and the wires from the blasting cap are wound loosely around the iron wire to prevent the breaking of the electric wiring to the dynamite charges.

Another means of loading is through pipes or casings sunk in the fill material to the desired depth. Before loading, a small charge—a stick of dynamite—is sometimes lowered to the bottom of the casing and exploded electrically to form a pocket or chamber in the muck of sufficient size to receive the working charge of up to 150 pounds of dynamite. The casings, however, are removed before the heavy shooting is done.

Shooting electrically is usually done in series—several charges fired simultaneously by means of electric blasting caps and a blasting machine which generates the current to fire the caps for detonating the charges.

For cross-section blasting and, in some cases, for the deep shooting after the fill material has been deposited in a pile, the shooting is by the propagated method. In this way a line of holes, parallel rows or a center line and radial lines can be shot if there is present sufficient water in the soil to carry the "explosion wave" from load to load of dynamite once the wave is set in motion by the detonation of a single initial charge.

Before depositing fill material on a road line across a swamp or marsh, preliminary shooting should be done to destroy the "mat" of vegetable growth and decayed vegetable matter which is often several feet thick. Otherwise, such a mat will more or less "raft" the fill material and may divert it to one or both sides of the road area. Such shooting liquefies, in a measure, the mat substance and permits the fill material to sink considerably by its own weight.

To the du Pont Company should go the credit for most of the developments in connection with accelerated fill settlement methods and their variations as outlined here.

Fill material piled within road lines before sub-surface blasting. For either three-point or casing loading the material should be piled high for a deep fill

ASQUITH AND KITCHENER

A Biographical Study of Two Eminent Englishmen

By CAPTAIN W. D. PULESTON
United States Navy

POSTERITY will pass judgment on the prom actors in the World War, but the present generation will certainly form its own opinions.

this careful appraisal of two of

by a trained analytical observer, and suggest that they re-read the previous articles by the s_ author on Clemençeau and Foch which appeared in our issues for May and June, 1931.
—*The Editor*

THE severest test of any form of government is a prolonged war. In practice the responsibility of government falls on certain individuals. In Great Britain during almost two years of war these enormous burdens lay heaviest on the shoulders of Asquith and Kitchener. When they undertook their Herculean task in 1914 these two leaders were barely past 60, which means they were born and reared in the full influence of the Victorian ideals when Englishmen were openly earnest and when they bore their "white man's burden" proudly.

They came roughly from the same stratum of society, the upper middle class, Kitchener from an army family, Asquith from puritan Yorkshire non-conformist stock. They both were spared grueling poverty or stifling wealth. Asquith entered Balliol College, Oxford, in 1869, one year after Kitchener entered the Royal Military Academy at Woolwich to begin his career in the Royal Engineers.

ASQUITH'S career at Oxford was one triumph after another, while Kitchener plodded his way through Woolwich scarcely distinguished from his classmates except by his common sense. Even then Kitchener was hard to know and made few friends, while Asquith was duly elected President of the Oxford Union, the famous undergraduate debating society; but already Kitchener had made several visits to Europe studying French and German while Asquith knew only England.

Kitchener was a devoted member of the Church of England, joined the English Church Union and after his first visit to Palestine became a member of the Army Guild of the Holy Standard. Asquith, following his non-conformist antecedents, early in his parliamentary career led the fight for the dis-establishment of the Welsh Church.

After their academic years, without money or influence, these young men ; thrown on their own resources. Asquith stayed at home and, while pre-

Above: Asquith as a rising young solicitor, and *right:* the veteran statesman after the World War

paring for the bar, coached candidates for Oxford, married early, and raised five children by his first wife. Kitchener accepted an arduous surveying detail in Palestine, and studied the Arabic language. Their periods of probation were comparatively short. Asquith passed rapidly from law to politics, attracted Gladstone's attention, entered Parliament from East Fife in 1885, and entered Gladstone's last Cabinet as Home Secretary in 1892.

Kitchener's advance was almost equally rapid. By accident or design he was in Alexandria on leave from Palestine, when the British Fleet bombarded that city in 1882; and in 1883, at the invitation of Sir Evelyn Wood, he became second-in-command of the Egyptian cavalry, consisting at the time of only one regiment; he took part in the unsuccessful effort to relieve "Chinese" Gordon in Khartoum; returned to England for a brief visit in 1885, when he was presented to Queen Victoria, and gained her lasting and valuable friendship. From 1885 to 1892, Kitchener served in Zanzibar, eastern Soudan, and Egypt in various positions combining military, administrative, and judicial functions. He throve under a tropical sun and while working long hours i the tropics, his health actually in proved. Only the damp, chill climate of his native England seemed to disagree with him.

Kitchener's period of subalternship was now over; he had gained the confidence of his military and civilian superiors, including such men as Lord Salisbury, Lord Roseberry, Lord Cromer, and Field Marshal Sir Evelyn Wood. And in the spring of 1892, just as Asquith was about to enter Gl stone's cabinet, Kitchener became Sirdar of Egypt. These two Englishmen, destined to work together for England's safety in the stress of war, were rising

in their widely separated spheres at almost the same relative rate.

Asquith first attracted Gladstone's interest as a free lance Liberal orator; in the middle eighties he defended Gladstone's action in sending Gordon to Khartoum, his attempted recall of Gordon, and the failure to rescue Gordon; while Kitchener gained his first prominence by the part he played in Gordon's attempted rescue. Asquith admits that defending the course of the Liberal gov-

ernment in the Khartoum incident taxed his dialectical abilities, and Kitchener found himself much embarrassed in his efforts to assist Gordon by the inconsistent attitude of both the English government and Lord Cromer.

Events now moved more rapidly for Kitchener than for Asquith. In 1895, the Salisbury government, a coalition of Tories and Liberal Unionists, overthrew Gladstone's government. Asquith, although preserving his seat in Parliament, lost his office, and his lack of private means forced him to return to the bar to support his growing family.

Lord Salisbury's party had severely censured Gladstone's failure to relieve Gordon, so it was not surprising that in 1896 the new government decided to begin the reconquest of Soudan. Kitchener was selected to command and having already reorganized the defeated and disheartened Egyptian Army, within three years he built a 230-mile railroad across a desert, fought a successful campaign against a band of Moslem religious fanatics, and firmly established the British position in northeast Africa. At Fashoda, where he encountered the triumphant French column under the intrepid Colonel Marchand, he adjusted a diplomatic incident that might easily have involved France and England in war.

KITCHENER went from Egypt to South Africa to act as Chief of Staff for Lord Roberts, being personally nominated for this position by the Prime Minister, Lord Salisbury. After Roberts had destroyed Kruger's organized opposition, Kitchener was left in command with the more unpleasant task of suppressing the fast moving column of Boers who, under able partisan leaders, offered the same form of resistance to Kitchener that Marion and Sumter offered to Cornwallis during our Revolutionary War. For 18 long months Kitchener pursued his wary, well-horsed opponents, nor did he hesitate to destroy crops, drive off cattle, and burn houses and barns in his campaign to defeat the Boers.

As early as February, 1901, Kitchener was in conference with Botha, seeking some formula of peace that would keep the two South African republics within the British Empire, and in spite of his rigorous method of waging war, he was able a year later to take a leading part in conciliating the Boer leaders because of the confidence Botha had in Kitchener.

The South African War taxed Kitchener's capacity and physical strength and his letters to intimates reveal the despondency that occasionally engulfed him. During the long struggle he wrote a very modest letter to Broderick, the Secretary of War, suggesting that perhaps it would be wise to relieve him. Kitchener had foreseen the coming of the Boer War and in June, 1899, outlined a plan of campaign that was modeled after his successful Soudan campaign, in which light railways played a large part. But he found the mobile, intelligent Boers quite different from the fanatical Soudanese. The unwillingness of the Boers to submit to discipline and the greater strength of the British Empire eventually enabled Kitchener to bring the war to a successful conclusion, but only after a resistance that almost exhausted Kitchener, then in the prime of his manhood.

As Commander-in-Chief of the South African Field Force, Kitchener was in intimate association with Lord Milner, the British High Commissioner to South Africa, and during a four months' absence of Milner, Kitchener acted as

Below: Kitchener thrived on his early African work. *Right:* The Kitchener the War generation knew

High Commissioner and Commander-in-Chief. He again showed his ability to work in harmony with the civil authorities and Milner bore witness that Kitchener by "untiring energy—indomitable persistence– stoical courage—had brought complete success" and was "esteemed—by the men whom he fought and conquered."

In July, 1902, Kitchener returned to England to receive almost royal honors, and after a brief rest proceeded to India as Commander-in-Chief of the Indian Army.

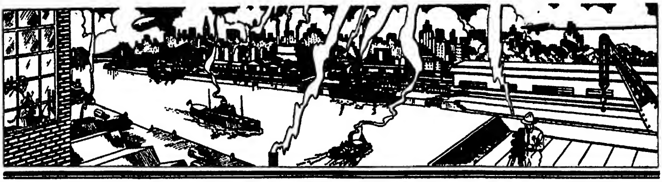
In 1891, Asquith's first wife died, and in 1894 he married Margot, the youngest daughter of Sir Charles Tennant. The vivacious Margot brought into the serious life of Asquith a brighter and lighter note. He was also beginning to emerge successfully from the drudgery that had marked his earlier days at the bar. Hereafter Asquith took more pleasure in life and later, amid the busiest days of his premiership, would steal a few hours to spend with the high-spirited coterie that formed a congenial circle around his brilliant wife. Some of his older friends looked askance at the gaiety of some of his newer associates; others wondered whether his earlier crusading spirit had not diminished, and one critic pointed to pictures of the younger and older Asquith as proof that his second marriage had softened him. Asquith himself, certainly a well

informed witness, testifies that he v blessed beyond his deserts in both n riages.

The Boer War divided the Liberal leaders into two groups; Roseberry, Grey, Haldane, and Asquith supported the war and were dubbed Imperialists, while Harcourt, Morley, Campbell-Bannerman, and Lloyd George opposed the war and were called pro-Boers. Gladstone was dead and no Liberal leader seemed capable of uniting the two factions. The Khaki election in 1900 gave the Conservatives another five years in office; thus during the decade 1895-1905 that brought Kitchener world wide recognition, Asquith to outward appearance was merely warming the opposition benches in Parliament. During this period in opposition, Asquith drew very close to Grey and Haldane without losing the esteem of Campbell-Bannerman, who had succeeded Lord Roseberry as the leader of the Liberal Party.

During the decade of Liberal opposition, Campbell-Bannerman undertook the difficult task of keeping the two groups together; Asquith was gradually recognized as second only to the leader in party councils. In 1905 Campbell-Bannerman led the Liberals to a decisive victory at the polls, and made Asquith, Chancellor of the Exchequer; Grey, Foreign Secretary; Haldane,

(*Please turn to page* 138)



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Discovers Last Chemical Element

AFTER a year of continuous scientific experiments, Dr. Fred Allison, professor of physics at the Alabama Polytechnic Institute, has announced the discovery of evidence indicating that "Element 85," the last of the undiscovered chemical elements, has been found in sea water, fluorite, apatite, monazite sand (Brazilian), kainite (Stassfurt), potassium bromide, and the laboratory reagents, hydrofluoric and hydrobromic acids.

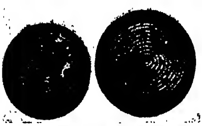
The announcement is not final, but the evidence obtained caused Dr. Allison to refer to it as a "high order of probability" of the presence of this element in the compounds named.

If the element 85 evidence becomes conclusive, all of the elements of the universe will be known to science. Their discoveries have been in progress for more than a century. Several have been found within the last decade, but no scientist had perfected a method capable of detecting "85" and "87" until Dr. Allison produced his magneto-optic method, which is capable of detecting one part of substance in 100,000,000,000.—*A. E. B.*

Marine Electrolysis Eliminator

AN electrolysis eliminator which its Seattle manufacturers claim ends for all reasonable time the present "cancer" of electrolysis which eats away stern bearings, propellers and propeller shafts, rudders and shoes, is now being marketed on the Pacific Coast by the Marine Electrolysis Eliminator Company, after two years of demonstration on nearly a hundred Puget Sound ships.

The device, which is slightly concave and circular in shape, comes in three sizes, and is usually attached in pairs to the bottom of the ship, with a copper-wire hook-up to the engine, the water circulation system, the stern bearing, and the stuffing box on the propeller shaft. It is claimed that the present cause of the many trips to the dry-dock made by salt-water craft is the fact that the circulating water system, with its brass and iron piping and salt water for an electrolyte, constitutes a perfect galvanic battery. No effort is made to alter this fact, but the current's flow is reversed ingeniously.



On the left is the core of a marine electrolysis eliminator showing the action of electrolysis during nine months use on a ship's bottom. At the right is a new eliminator

With the eliminator installed, a removable core or electrode is the only article eaten away, the flow of formerly destructive current is reversed and electroplates and improves bearings it formerly gnawed away. "Cures" of cancerous electrolysis that formerly ate out stern-bearings as often as eight times in four months and have now been judged "permanent" after a year's operation and a dry-dock examination that proved no repairs to be necessary, are claimed by the company.

Bladder and Kidney "Cures"

IN connection with its continuing survey of medical preparations offered as cures or treatments for the more serious diseases of man, the Federal Food and Drug Administration plans, in the coming months, to direct special attention to products labeled as being effective in the treatment of diseases of the kidneys and bladder, Dr. J. J. Durrett, chief of the administration's drug-control laboratory, announces. Investigations which have been under way for several months indicate that several of these products are on the market, most of them containing ingredients possessing diuretic properties. "Where such ingredients are present in appropriate dosages," says Doctor Durrett, "the administration will not object to their being labeled as diuretics. Such preparations, however, by no means constitute treatments for the various diseases of the kidneys and bladder, among which are some of our most serious maladies. In fact, these preparations are sometimes harmful to a person suffering from these ailments."

Doctor Durrett states that although the Federal food and drugs act does not prohibit the sale of dangerous or deleterious drugs if they are truthfully labeled; nevertheless, sufferers from diseases of the kidneys and bladder are usually not able to diagnose their troubles nor to determine the character of treatment needed. In particular, they are unable to determine for themselves whether the diuretic would be useless, helpful, or harmful to them. Under the law, however, if an article which does possess diuretic properties is labeled simply as a diuretic, it is not misbranded. The administration's jurisdiction ends with seeing that labels of these medicines are truthful, both literally and in the implications which their wording conveys.

Sulfurless Rubber Avoids Tarnish

INVESTIGATION by the National Bureau of Standards has shown that the use of trinitrobenzene instead of sulfur as a vulcanizing agent for rubber produces a product which has no apparent action on such metals as copper, silver, and mercury. For example, when trinitrobenzene rubber is vulcanized in contact with copper, the metal remains bright and the aging qualities

A newly installed electrolysis eliminator on the bottom of a vessel

of the rubber are practically unaffected. Such rubber may find an important application in the manufacture of electrical insulation, since it may be applied directly to the copper without first tinning the latter. The electrical resistance is somewhat less than that of sulfur-vulcanized rubber, but adequate for practical insulation purposes. —*A. E. B.*

Pointers on Nail Points

THE point of the nail, more than the shank, determines splitting and holding qualities, according to the United States Department of Agriculture.

Investigators at the Forest Products Laboratory of the Forest Service have found that, in general, the nails with the sharper and longer tapered points develop more holding power than those having the common type of point, but they also show a greater tendency to cause splitting—especially in the harder woods—owing to the fact that they merely force aside the fibers with relatively little mutilation.

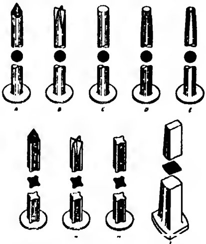
The blunter points of various shapes, because they shear off and upset the fibers in driving, have less holding power, but also less tendency to split wood.

Considering that blunt-pointed nails are effective in reducing the tendency to split the wood in nailing, and that within rather wide limits the holding power of nails depends on the length of nail in contact with displaced but unbroken wood fibers, the following general suggestions are made regarding nailing practice as affected by the type of nail point:

In light-weight woods, or in the denser species which do not split in nailing, the greatest holding power is obtained with sharp-pointed nails.

In woods which split with the common-pointed nails, two alternatives are open (aside from driving into bored holes, which gives the best results): Use nails of smaller diameter, if feasible, increasing the number to give equivalent holding power, or use blunt-pointed nails of the same length and diameter as would be used with the common-pointed nail.

The Forest Products Laboratory has designed a nail that has less tendency to cause splitting than common-point nails, and better holding power in many woods. The improved nail is tapered to the point for about a fifth of its length. The point may be either flat or slightly rounded and of any convenient shape—round, square, or otherwise. The characteristics of the nail can be varied by varying the diameter of the rounded or flat tip—without varying the length of taper—from approximately one fourth the diameter of the shank for softwoods to about three fourths the diameter of the shank for hardwoods. The blunt point of the nail just described, when used in a size adapted to the wood into which it is driven, produces sufficient shearing of fibers to obviate excessive splitting. The long taper aids in bringing the shank of the nail into intimate contact with the wood without further fiber mutilation or excessive wedging action.



Some of the nails investigated by the United States Forest Products Laboratory, showing, D and E, the two types recommended by them

A Modern "Gambling Joint"

AS much as 250,000 dollars is sometimes spent by the Aluminum Company of America in research, with no guarantee that commercially practical results will be secured. But the company has been highly successful in these scientific "gambles" says *Chemical and Metallurgical Engineering* and even when desired results did not materialize, other business has been developed in by-products of research. The company has lately built a new million dollar central laboratory at New Kensington, Pennsylvania, beautifully modern as a "lab" and also beautiful architecturally and in landscaping. *A. E. B.*

Staticat?

CAN a cat emit static?

If you stroke a cat's back in a dry, heated room you can produce sparks, but what about the cat in the accompanying photograph, which appears to be fairly bristling with sparks?

This photograph was submitted by a reader in Los Angeles, Mrs. Raymond Shields, who states in her letter that she did not notice anything unusual at the time the picture was taken. "But," she comments, "after the picture was developed I remembered that I had picked up the cat immediately following the exposure and he snarled at me- something he has never done. Evidently he either received a shock or it hurt him in some way. A radio aerial is on top of the building in the background; could that have had any connection with this peculiar phenomenon?"

An interesting little problem; especially in view of the fact that science still has much to learn concerning peculiar electrical effects and therefore cannot arbitrarily rule out any one of them merely because it is unknown.

Courtesy Mrs. Raymond Shields

A correspondent wanted to know whether the static was emitted by the cat in the picture. The static at left of picture bears out an expert's explanation

It is easy to connect the presence of the radio with the spark—though just exactly why this should be done is another problem, since ordinary radio antennas are not known to do much sparking, even *via* cats. Moreover, the cat does seem to wear a rather annoyed, resentful expression. The conclusion seems obvious, at least if one has enough of the will-to-believe, that this cat is a broadcaster of static.

However, as a precaution, the photograph was sent to the Eastman Kodak Company, whose employes know much about photographs, and the following reply was received:

"The marking on the negative is, as you infer, produced by static and would have occurred under the same conditions, regardless of the subject photographed. The result can be produced by rapidly unrolling a spool of film and in cold, dry weather the effect is so pronounced that the sparks can be readily seen in a photographic darkroom."

Ultra-Violet Light in Tuberculosis

THE use of ultra-violet rays from the carbon arc and the quartz mercury vapor arc has become generally known to the public and seems to have certain definite effects on the body. Thus, it is specific in controlling rickets and sometimes of help in tuberculosis of the intestines, of the lymph glands, and of the bones and joints.

Evidence as to any other virtues that it may have is not so well established as to be considered proved. In order to test its effects Doctors H. S. Willis and J. Cohen of the Johns Hopkins University Hospital treated groups of patients with ultra-violet rays and controlled their studies by screening one of the burners with window glass, which does not permit the short ultra-violet rays to pass. In their discussion the authors point out that the long ultra-violet rays may pass, that these rays penetrate the skin slightly (about 3 millimeters or one eighth inch), that the skin of the colored races absorbs more ultra-violet rays than that of the whites and that the exact difference in effects between the long and the short rays is not perfectly established.

The patients studied included persons with tuberculosis of the glands, of the bones and joints, of the intestines, and of the skin, and also some patients with anemia and others convalescing after operations. Ninety-one were treated with unscreened lamps and 47 with screened lamps. When all of the cases were considered it was found that just as many cases improved without the short ultra-violet rays as with them, but the patients with tuberculosis of the glands

Courtesy Field Museum of Natural History

This mammoth beryl crystal, weighing approximately 1000 pounds, was presented to the Field Museum by William J. Chalmers. This is believed to be the largest crystal of this mineral, a relative of the precious emerald, ever discovered

showed a higher percentage of improvement under the ultra-violet than those without. The authors found that the patients who were receiving the short ultra-violet rays felt better, ate better, and gained weight better than those who were receiving the screened rays. They feel that this was not a mental effect, since the patients who received the screened rays did not indicate anything like a similar beneficial effect.

Studies of this type help to establish scientifically the actual merits of such methods for the treatment of disease. They should, however, be made on a much larger scale and with a more certain control of all of the factors concerned.—*M. F.*

Old, Old Story Won't Down

WILL ancient seeds sprout? The editors of all scientific journals receive this question about once a week, yet no matter how often the belief is downed, it will not stay down. The same question has been answered by *Nature* (London) which states:

"For many years now, a popular belief has existed that seeds which have been removed from ancient tombs retain their ability to germinate. Wheat grain, the so-called 'mummy wheat', has been a case in point for several decades. This question was brought forward again during the discovery and examination of the tomb of Tutankhamen in 1923, by Howard Carter and Lord Carnarvon, and has received attention from various quarters since that date. Now another claim has been made by an American farmer, that wheat taken from the tomb of Tutankhamen has been made to grow, and this fact has received much publicity in the press. It is all a question of viability.

"The viability of a seed depends on several factors, both internal and external. Some seeds will not germinate immediately, and are said to be dormant, such dormancy again being conditioned by after-ripening processes, and so on. The result is that seed viability varies considerably within the plant kingdom. For example, the acorn is viable for one season only, whereas charlock will last for 20 or 30 years. Hawthorn, even given germinating conditions, remains dormant for the first season; but immature wheat will germinate, given the necessary conditions, as seen in the case of wheat germinating when still in the ear, during a wet season. On the other hand, mature wheat is viable for some considerable time. Not only that, the grain can withstand extreme conditions to an exceptional degree. Other plants show a similar tendency."

The same subject was discussed in *Nature* many years ago by W. Botting Hemsley, who stated that "kidney bean seeds, which had remained in the herbarium at Tournefort for 100 years, germinated; and *Mimosa pudica* will remain viable for 60 years.

"But the viability of wheat thousands of years old is a different matter. Sir E. A. Wallis Budge states in the *Times* that grain from a tomb of date 1200 B.C. was tested for him by the late Sir William Thiselton-Dyer at Kew, and gave negative results. Many others, too, have tried since, with similar results. Yet, such positive results as claimed by some, need explaining.

"The question is: Were such claimants sure of their wheat? For hundreds of years, the halls of tombs have been used as granaries by the natives. The grain can conceivably be ascribed to that, and therefore possibly be only a few years old. Also, 'mummy wheat' has become so popular that guides have resorted to tricks whereby they dig up 'mummy wheat' (in the presence of the tourist) which the guides themselves had placed there some time before. So far, there has not been one authentic case of 'mummy wheat' being viable, and it is extremely unlikely that there ever will be. A viable seed is still living and therefore respiring, however slowly. Decay is therefore taking place, since there is no anabolism. Such decay varies in rate; but it is not likely that it is so slow as to last over thousands of years."

Still the story probably will not down.

New Zinc Process

A REVOLUTIONARY new process of producing high-grade metallic zinc by the use of methane or natural gas as a reducing agent, devised by Charles G. Maier, metallurgist, at the Pacific Experiment Station of the U. S. Bureau of Mines, was described at a recent meeting of the American Zinc Institute held in St. Louis.

A critical study of zinc smelting with the object of reducing production costs and improving the quality of the zinc was begun by the Bureau of Mines three years ago. The new process is a by-product of these basic studies and is additionally remarkable as being an application of precise knowledge of chemical fundamentals.

Recent improvements in metallurgy require higher grades of zinc. Formerly prime western spelter was the standard of quality, but now the stage has been reached where electrolytic zinc of 99.99 percent purity is the standard. The new process is expected to produce zinc fully as pure as any commercially available today.—*A. E. B.*

Anti-Knock from Ocean Water

OCEAN water will become to a greater extent the source of chemicals from which anti-knock compounds for motor gasoline are made if experiments now in progress prove successful. The Dow Chemical Company and Ethyl Gasoline Corporation are undertaking a joint venture for further production of bromine from ocean water. The Dow Chemical Company is the largest manufacturer of bromides in the world. Ethyl Gasoline Corporation is a subsidiary of General Motors Corporation and Standard Oil Company of New Jersey, and is now the largest user of bromides in the world. It manufactures an anti-knock compound for gasoline marketed under the trade name "Ethyl." Ethylene dibromide is used in the manufacture of Ethyl fluid and the popularity of Ethyl gasoline has greatly increased the demand for bromides.

Under an arrangement with Ethyl Gasoline Corporation, The Dow Chemical Company has undertaken to construct and equip an experimental plant for the extraction of

A cloud of smoke escaping (at right) from the dust explosion investigations house in Virginia

bromine from ocean water. A strip of land three fifths of a mile in width and extending from the Atlantic Ocean to Cape Fear River—about two miles north of old Fort Fisher—has been acquired for the purpose of locating the experimental plant. This location is about 17 miles south of Wilmington in New Hanover County, North Carolina. The plan provides for utilizing ocean water and, after extracting the bromine, discharging into Cape Fear River. It is expected that construction work will begin in the very near future, with the hope of having the experimental plant in operation during the present year. If the plan proves feasible, the two companies intend to organize a subsidiary corporation and

construct a plant for commercial production on a large scale.

According to United States Bureau of Mines figures, the bromine recovered in 1930 by the producers from natural brine, and the bromine content of bitterns used in the manufacture of bromine compounds, was 8,462,800 pounds valued at 2,109,974 dollars. This was an increase of 32 percent in quantity and 20 percent in value over the output of 6,414,620 pounds valued at 1,759,325 dollars in 1929. In 1930 as in 1929 the increase was due in most part to bromine required for ethylene dibromide used in the manufacture of Ethyl gasoline. —*A. E. B.*

A Diesel on the Race Track

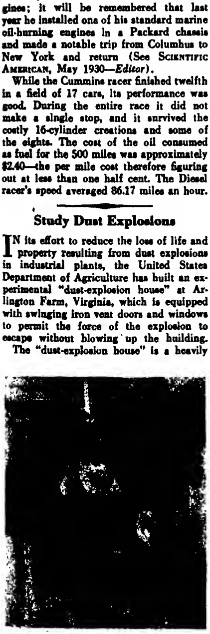
TO our knowledge the first Diesel-engined racer ever to be entered in a race on the Indianapolis Motor Speedway, C. M. Cummins' car made such a good showing during the annual 500-mile race on May 30 as to excite widespread interest. Mr. Cummins, the designer, of Columbus, Indiana, is a builder of marine Diesel engines; it will be remembered that last year he installed one of his standard marine oil-burning engines in a Packard chassis and made a notable trip from Columbus to New York and return (See SCIENTIFIC AMERICAN, May 1930—*Editor*).

While the Cummins racer finished twelfth in a field of 17 cars, its performance was good. During the entire race it did not make a single stop, and it survived the costly 16-cylinder creations and some of the eights. The cost of the oil consumed as fuel for the 500 miles was approximately $2.40—the per mile cost therefore figuring out at less than one half cent. The Diesel racer's speed averaged 86.17 miles an hour.

Study Dust Explosions

IN its effort to reduce the loss of life and property resulting from dust explosions in industrial plants, the United States Department of Agriculture has built an experimental "dust-explosion house" at Arlington Farm, Virginia, which is equipped with swinging iron vent doors and windows to permit the force of the explosion to escape without blowing up the building.

The "dust-explosion house" is a heavily reinforced compartment of approximately 100 cubic feet volume. Engineers in the Bureau of Chemistry and Soils are now conducting experiments to determine the proper venting area necessary to protect buildings of various sizes in industries subject to dust explosions. Dust explosions are produced in the experimental house at will by blowing starch, flour, grain dust, or other powdered combustible material from a number of hemispherical cups. The dust cloud is ignited by blowing it on a heated electric coil.



One of the iron vents for the escape of gases in dust explosions

There are at least 28,000 industrial plants in the United States subject to danger from dust explosions, the department engineers say. These plants employ more than a million workers and manufacture products with an annual value in excess of ten billion dollars. Among the various products which yield explosive dusts are grain, starch, sugar, wood, paper, cork, fertilizer, dried milk, chocolate, rubber, and sulfur.

A New Endurance Flight Record

THE fuel economy of the new Packard Diesel airplane engine was again demonstrated when pilots Walter Lees and Fred Brossy kept a Bellanca plane, with enlarged wings and a Packard Diesel engine, in the air over Jacksonville Beach, Florida, for 84 hours and 33 minutes, landing at 7:20 P.M. on May 28. Replying to our congratulations on this splendid achievement, Alvan Macauley, President of the Packard Motor Car Company, gave such an interesting account of the successful flight and the two previous ones that we asked for, and were given, permission to publish his entire letter. It will be noted from this letter, which follows below, that even after setting a record that promises to stand for some time, the plane landed with sufficient fuel for another four or five hours of flight.

"Dear Mr. Munn:

"We very much appreciated your telegram received this morning, congratulating us on the performance of the Packard Diesel at Jacksonville Beach, Florida, where we won the world's record for continuous non-refill flight by nine hours and ten minutes. As you well know, a test of the kind we undertook requires sound fundamentals, a trained and conscientious personnel, and several months of careful preparation. Our two aviators even went to the extent of dieting, losing about 10 pounds each, in order to favor the success of the venture.

"So far as I know, neither Walter Lees nor Fred Brossy, our pilots, is a dramatic writer. If either were, he could tell an interesting story of the last two flights. We made three attempts. In the second attempt, when within an hour and fourteen minutes of the world's record, a terrific storm broke that was appalling in its intensity. The aviators were flying on the beach, water on one side, jungle on the other. They recognized they must either escape the storm or land with the record almost in sight. The rules required them to keep within observation of the flight officials. They headed for the storm and measured its height and width, hoping to find a way up or through. Up was apparently out of the question, as they would have gone out of the view of the flight officials. It was evident the black clouds were too heavy to see through, if they were at any considerable height. They skirted the whole front of the approaching storm and found no opening, so they returned to their beacon to await the possibility of riding out the storm. As it broke upon them it was increasingly evident the storm could not be mastered. For a time they circled closely, one man with his head out of the window keeping the beacon in sight, and the other piloting. The rain meanwhile descended in torrents, accompanied by a high wind. It became worse and worse until navigation became almost impossible as dusk deepened. Finally the pilots were obliged to make a hurried landing 11 miles down the beach and actually out of sight of the official observers, so they were unable in this second attempt to get even credit for having broken the American record, as they did by a comfortable margin.

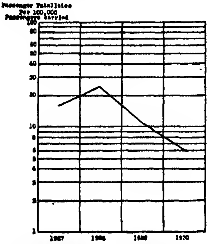
"The third and successful effort was less dramatic, but still very interesting. Throughout all the trials the motor functioned perfectly. They arose from the beach easily regardless of the weight of the plane in comparison to the size of the wings. They drew for fuel first from the belly tank, releasably attached to the under side of the fuselage. On attempting to release the belly tank, however, it wouldn't release and they had to carry it about 12 hours before they ingeniously contrived to trip the latch and drop it upon the beach. Then they began to use the fuel stored in five-gallon cans in the cabin and all went well until, after emptying one of the cans and throwing it out, it caught on the stabilizer brace. Mr. Brossy, the pilot, at intervals attempted by banking and diving the plane, to dislodge the can, but without results. Finally Walter Lees, the senior pilot, crawled back into the rear of the plane, slit the fabric, reached out and was able to remove the obstruction, which had become a serious menace, afterwards sewing up the fabric and repairing it so that it lasted to the end of the flight. After that, they had a few near storms but wound up the flight successfully and uneventfully and settled on the beach just before nightfall with sufficient fuel to have continued the flight for four or five hours longer.

Interior of dust explosion house showing cups from which various dusts are blown for test explosions, and the ignition coil in front

"An interesting fact was that they were unable to gage accurately the proper proportions of fuel oil and lubricating oil to take aloft. They found as time passed that they had too much lubricating oil, so they simply dumped it in the tanks, mixing it with the fuel oil, and consumed both. About 15 gallons of lubricating oil were used in

this way. Towards the latter part of the test, therefore, they were being driven by lubricating oil. It didn't seem at all to bother the motor, which will run on almost any liquid fuel. It does very well, you know, on kerosene.

"While in Jacksonville no effort was made to stretch the mileage or to travel at high speed, it is significant that the distance cov-



Passenger safety is increasing on our scheduled air transport lines

ered was considerably more than enough to fly from New York to Europe and return without touching land for refueling, or to make the round trip from New York to California and return. We shall have more exact figures as to the distance traveled, which has been estimated at 6600 miles. At that figure the plane could have flown around the earth with but three stops for supplies.

Cordially yours,

ALVAN MACAULEY, *President*"

Aviation Significance of Piccard's Flight

OUR newspapers have "covered" Professor Piccard's splendid flight in so complete a fashion that we will not burden our readers with a complete story. We will endeavour to answer but one question. Has this balloon expedition any significance for aviation? It has.

It is only a question of a year or two before practical experiments will be made with altitude planes in which the passengers will be seated in a hermetically sealed cabin supplied artificially with air at ground level pressure; the engine will be supplied with supercharged air so that power will be maintained at altitude; greater speeds will be attained than is possible in navigation at lower levels.

Also in a few years more, the rocket will be the subject of practical experiments for carrying mail across the Atlantic. If a rocket can be projected high enough, it will enter a region of very thin air, where the air resistance will be almost negligible. We do not believe in rocket airplanes, but we do believe that a rocket designed on the principle of a projectile can be made to work ultimately. The rocket will rise to great heights, and travel along a parabola, just like a shell, with the advantage that for the major part of its flight it will be flying in what is, to all intents and purposes, a vacuum. Professor Piccard's flight will give us more data about the stratosphere, that region of the atmosphere, more than 12,000 meters in height, where the temperature no longer drops as altitude is further increased; that, at least, is the generally accepted theory. Any such data will, of course, be invaluable to designers of altitude craft.—*A. K.*

Airplane Reliability

IT MAY be true that the aviation industry is passing through a period of depression and adjustment; aircraft manufacturers have been particularly hard hit and inventories are being adjusted only by severe price cuts and strict limitations of production. In air transport operations, on the other hand, progress is rapid and entirely satisfactory.

The Aeronautical Chamber of Commerce reports that during 1930, 34 air transport lines reported a total of 28,833,967 miles flown in scheduled operations, or an increase of 42.4 percent over 1929. Still more remarkable is the increase in passengers carried—385,910 passengers were carried on scheduled lines in 1930. This is an increase of 220,647 passengers or 134 percent above the number carried in 1929. Passenger miles for the year 1930 total 94,545,744. The average length of a passenger trip, for the year as a whole, was 245 miles.

Still more remarkable is the progress made in reliability and safety.

Less than 7 percent of the total trips scheduled by the 34 lines were not com-

Tank of CO_2 for the fire extinguisher, under an airplane cowl

pleted. The trips scheduled but not completed total 3275. It is interesting to analyze the causes that led to abandonment of these trips: 91 percent were abandoned because of bad weather; insufficient traffic accounted for 6.44 percent; other causes for 1.1 percent; mechanical difficulties were responsible for only 1.46 percent of the trips abandoned. This is a remarkable tribute to the present reliability of the airplane.

As a result of this increased mechanical reliability, of the efficient aids to navigation installed by the Department of Commerce, and of the stringent rules propounded by the Department, there was also a highly satisfactory decrease in the rate of passenger fatalities for the year 1930. More than 3,900,000 passenger miles were flown for each individual passenger fatality. This is equivalent to a plane with ten passengers flying 15 times around the earth at the equator, for each individual fatality recorded.

The progress in passenger safety is strikingly illustrated by an accompanying chart. The first burst of passenger traffic increased the fatalities per hundred thousand passengers carried to something like 25 in 1928. By the middle of 1930, the graph shows that the number of fatalities sank to six per hundred thousand and the trend of the graph is evidently sharply downwards. While there is no doubt that passenger air travel is still far from approaching railroad safety, it is quite evident that the airplane is getting safer from day to day.—*A. K.*

A Practical Aircraft Fire Extinguisher

TO anyone who has seen an airplane crash to the ground and burst into flames with the occupants pinned beneath the wreckage, fire hazard remains an unpleasant memory. Anything that can be done to minimize fire hazard is worth while. Pending the development of the fuel-oil aircraft engine, one of the most practical safety measures is the installation of permanent fire extinguisher equipment on board the airplane.

One of the effective fire extinguishers now available, called the "Lux" extinguisher, consists of three major parts. One is a steel cylinder containing carbon dioxide at 850 pounds pressure. Carbon dioxide is an inert, non-poisonous substance which cannot support combustion and which puts out an engine fire the moment a cloud of the gas surrounds the engine. Another advantage of this gas is that it is non-corrosive, dry, and clean and does not damage electrical or other equipment. The steel gas cylinder is usually installed in an upright position, behind the fire wall. The gas when compressed to 850 pounds is in liquid form, and is sealed by a metal disk. The second major part of the apparatus is the control and control panel, which is shown mounted at the left.

When used on a multi-engined plane, the control lever of the extinguisher can be set at the position corresponding to the engine which is in trouble. When in position, the handle can be pulled back and by an arrangement of a flexible cable, run in a quarter inch aluminum tubing, be made to operate a specially designed cutter valve on the cylinder, thus releasing the gas. The direction valve then allows the gas to dis-

Courtesy Walter Kidde and Company

Lux distributing tubing installed around the engine mounting with a loop about the carburetor and a nozzle in the carburetor intake

charge under its own pressure to the engine selected by the control handle. To distribute the gas, a perforated ring of tubing 7/16 of an inch in diameter, the third major part, is installed around the engine, with a perforated loop about the carbureter and an outlet in the carbureter intake. Even when the slipstream is driving the air past the engine, the carbon dioxide cloud has proved effective again and again in extinguishing violent flames.—*A. K.*

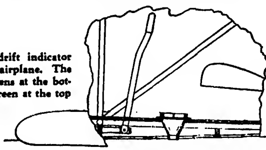
A New Drift Indicator

A PILOT may have his airplane correctly headed by compass, due north, along the line AH in one of our sketches. But if the wind is from the side and from ahead, as shown by the arrow W, then his actual course will be along the line AC. He will be drifting away from the correct course. The angle D will be the angle of drift. If no correction is made for this angle of drift, navigation becomes hopeless.

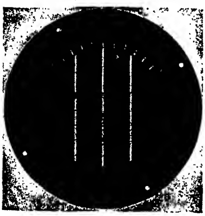
A variety of drift indicators have been employed. The latest and perhaps the most practical of such instruments is the Pioneer Drift Indicator.

This new instrument is shown in a photograph and its installation is illustrated in one of our sketches. It is a very light and compact instrument and is so mounted that observations can be made through the floor of the cabin without it being necessary for the pilot to open windows or to look over the side of the cockpit.

In the top of the instrument is mounted a ground glass 3¾ inches in diameter. A lens is inserted in the bottom of the funnel-shaped case. As the airplane moves over the ground, an image of the ground below is thrown upon the ground glass screen and objects on the ground appear to travel across the screen in the direction of the movement of the airplane. The screen itself is rotatable and is provided with parallel sight wires and an angular scale graduated from 0 to 50 degrees on both sides of zero.



Installation of the new drift indicator in the fuselage of an airplane. The funnel-shaped case has a lens at the bottom and a ground glass screen at the top



A "moving picture" of objects on the ground passes across the glass screen of this drift indicator

To make an observation of drift, it is only necessary to rotate the screen either to the left or right until objects on the ground appear to travel in a line along the screen parallel to the sight wires. The angle of drift is then read directly from the scale. In order to correct the compass course, the angle of drift is either added or subtracted from it. To prevent mistakes in deciding whether the drift should be added or subtracted, the instrument itself is plainly marked on the right side "add to compass heading" and on the left side "subtract from compass heading."

While flying at night, lighted objects, such as street lights or electric signs, show up on the screen with remarkable clearness. It is therefore just as easy to take a drift reading at night as in the daytime, provided of course that the plane is passing over lighted objects of sufficient brilliancy. —*A. K.*

Aids to Air Commerce

THE Chamber of Commerce of the United States is keenly interested in the continued progress of air transportation and has a special Committee on Aeronautics functioning toward this end. This Committee is composed of authoritative business men and representative air-line executives. The recommendations of this Committee to the Nineteenth Annual Meeting of the Chamber of Commerce are, therefore, worthy of serious consideration.

There should be, in its opinion, uniform aeronautic licensing laws, and the Committee urges those states which have not yet enacted legislation requiring Federal licenses for aircraft and airmen, to pass such legislation. Undoubtedly, this legislation would assure not only uniformity but a higher standard of flight safety throughout the country.

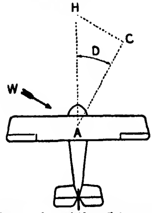
Again, the Committee urges that the states enact legislation enabling municipalities and counties to acquire, develop, and operate airports.

In spite of the perennial complaint that the laws of the country multiply too fast, the legislation under these two items, as we hope our readers will agree, would be entirely legitimate and reasonable.

The states are also asked to help in the local enforcement of the Air Traffic Rules of the Department of Commerce. They are, perhaps, more likely to secure local enforcement of Air Traffic Rules than observance of another famous set of rules which we will not name.

The Chamber also urges the extension of Federal airways and the increased building of proper landing facilities and airports. Air marking is undoubtedly of the greatest help to the pilot; to avoid confusion it should be uniform in character and with such uniformity of air marking, Chambers of Commerce in every city should be concerned.

Nobody thought of airport zoning a few years ago; now the subject is becoming acute from two points of view. The approaches to the airport must be zoned so that pilots are not hampered by tall buildings or high-tension transmission wires. On the other hand, the noise and dust pertaining to an airport may ruin a pleasant residential district. Therefore, restriction to airport sites also has to be considered.



How a plane drifts off its course as explained in accompanying text

The available supply of helium in this country is practically inexhaustible. Moved by the recent disasters in lighter-than-air flights abroad made with inflammable hydrogen gas, the Federal Government, reversing its previous policy, has arranged for the export of helium gas under certain restrictions for use in airships. The Committee approves and also suggests Federal legislation to encourage the development of commercial lighter-than-air services.

We feel that this is altogether a most constructive and reasonable report—*A. K.*

The Photo-Electric Cell in Fog Flying

EXPERIMENTS conducted by W. F. Westendorp of the research laboratories of the General Electric Company with a photo-electric cell may be of considerable service in fog or blind flying.

Fog consists of particles of moisture, or moisture surrounding particles of dust. When a beam of light travels through a fog, it is partially dispersed, partially absorbed. At any rate it no longer travels in a definite straight line. The eye can no longer see the source of light, but notes vaguely a certain diffused and weak light effect.

A photo-electric cell is much more sensitive to changes of light intensity than the human eye and, moreover, with the use of vacuum tube amplifiers, its indications can be greatly strengthened.

A photo-electric cell has been mounted at the tail of the plane, and provided with an amplifying system and two indicators in the pilot's cockpit. One indicator tells the pilot on which side the light is more intense; the other indicator tells him whether the light is becoming more or less intense. Hence with the aid of the photo-electric cell, he can judge on what side the airport beacon lies, and also whether he is approaching or leaving the beacon. A neon tube has been employed in these experiments, with a current pulsating at the rate of 1000 cycles a second. The experiments

so far have been extremely promising. We hope to give our readers more complete information on this interesting device a little later.—*A. K.*

Seaplane Float Test Basin

IN these days, when faith in the future of the United States seems to be slightly shaken, it is refreshing to think that our country leads at least in one or two things. The new 30 by 60-foot wind tunnel is the largest in the world and will greatly advance American aviation. The new seaplane channel opened by the National Advisory Committee, is also the largest and most advanced type of apparatus for testing floats and flying boat hulls.

Close-up of the new test kit with which investigations of the performance of airplanes may be made

Some 60 years ago, an Englishman by the name of Froude built the first towing basin, in which models of surface vessels were towed at a speed of some 10 miles per hour so that their drag or water resistance could be measured. Although marine people are most conservative, this form of investigation became popular quite rapidly and water towing basins are now available in all civilized countries. The towing basin at Washington has been active for many years, and all the important, modern vessels built for the Navy and for the American merchant marine have undergone model tests at this station. With the advent of aviation, however, the speeds of the Washington Navy Yard basin have become inadequate.

In the new channel at Langley Field, full size floats will be propelled through the water at a speed of 60 miles per hour. The carriage shown in our photograph is built of steel tubing, and is provided with two driving motors. The carriage runs on rubber wheels, and current is taken from the overhead rails after the fashion of an electric trolley car.

The channel is some 2400 feet long. This enables the carriage to maintain an absolutely steady speed for a run of 1000 feet, with sufficient margin for acceleration and deceleration. On the carriage are the observers and automatic recording instruments. Below the carriage, as our photograph shows, is the float to be tested, flexibly attached to the carriage. The suspension of the carriage and the arrangement of the weighing apparatus is such that the drag, the lift, and the pitching moments of the float can all be measured. The trim of the float can also be changed to suit the purposes of the investigation. It is expected that the new channel will greatly advance the art of float design, giving us finally floats which will provide the quickest take-off, the least spray, and at the same time the minimum aerodynamic resistance in the air.

A question often asked is: why can not water tunnels be built just like wind tunnels? The reason is that water is some 800 times as heavy as air, so that in order to build a water tunnel of a certain size and speed, 800 times as much power would be needed as in the air tunnel. While the power required in this new water channel is not negligible, it is not nearly as prohibitive as would be the case for an installation where the float would be at rest and the water made to circulate around it.
—*A. K.*

New Airplane Test Kit

ONE of the most important things in the construction of airplanes is the determination of its performance. The speed of an automobile has, as a rule, nothing to do with its safety, but in an airplane, certain aspects of performance are an inherent part of safety.

For example, it is very important to know the stalling speed of an airplane, or, in other words, the slowest speed which it can comfortably maintain when coming in to land with its engine off. Evidently, safety will be increased by ability to glide in at a slow speed. Rate of climb is also an important factor, as is the angle of climb. To be safe, an airplane must have a certain minimum rate of climb (400 feet a minute is required by the Department of Commerce), and it must also be able to climb at a steep angle with the horizontal so that it can clear obstructions nicely.

The take-off time is not so much a measure of safety but a short take-off time is of obvious desirability in airplane operation.

In multi-engined ships, it is indispensable that flight should be maintained with one motor out of commission. A multi-engined ship which cannot maintain height with one motor out, is actually more dangerous than a single-engined ship.

The determination of all these points in performance is quite a difficult and complicated matter and involves the use of many instruments. Hitherto, these instruments have been separately mounted and not standardized, but a new test kit brought out by the Pioneer Instrument Company is calculated to remove many of the difficulties involved. The various instruments are now mounted in a case which can be held readily in the observer's cockpit or attached to the instrument board through flexible suspension.

In the top left hand corner of the unit there is a clock equipped with a "stop" hand, as well as another reference hand which can be manually set by means of a knob in the center of the front glass. With this, time of take-off can be accurately determined.

In ordinary flying, it is high speed which is important. Therefore, the conventional air-speed indicator is graduated for high speeds. In the new test kit the air-speed indicator is specially calibrated for the low range of the speed with graduations at two miles per hour. The air-speed indicator is, in principle, an air-tight case with a flexible diaphragm in its center. One side of the diaphragm is connected to the pressure side of a pitot tube; the other side of the diaphragm is connected to the suction side of the tube. The difference in pressure moves the diaphragm and hence, the indicator.

It is customary to mount the pitot tube pointing outward ahead of the airplane wings. Unfortunately, the flow of air around the wings disturbs the condition at the pitot tube and makes it highly unreliable, particularly at low speeds. Therefore, for measuring the slow speed of an airplane, it is desirable to hang the pitot tube at the end of a long cable some 40 feet or so below the airplane. This is the plan to be adopted in the new test kit.

Another important feature is the measure of the rate of climb. For this a sensitive altimeter is employed which will show a change in altitude of 10 feet by a pointer

Full-size seaplane floats are propelled in this Langley Field channel at 60 miles an hour. The channel is nearly half a mile long, 24 feet wide, and 12 feet deep

measurement of slightly more than one eighth of an inch.

Making performance tests is great fun, but it also requires care and ingenuity and every improvement in instrumentation is a decided help—*A. K.*

A Giant Wind Tunnel

IN all wind tunnels the same principle is employed: a propeller draws the air past the model of the airplane; the model is mounted on wires or a spindle and the forces and moments are measured on carefully designed balances. The reason for the popularity of wind tunnels is that they allow the characteristics of the airplane to be carefully and readily studied before it is flown.

There are many tunnels now available in the United States, at Langley Field, at the Army Station in Dayton, and at the Guggenheim Schools of Aeronautics at Stanford, New York University, and so on. These tunnels have a working section at the narrowest parts of their channels of some eight or nine feet in diameter, and the average speed at which experiments are conducted is from 60 to 80 miles an hour. The airplane models employed are about 36 inches in span. These tunnels are of great usefulness to the airplane designer and in skilled hands give him much information. They may also be used to determine the value of an invention in the most practical and quickest fashion. There is, however, a "scale" effect which makes all results obtained in these tunnels inferior to those

The largest wind tunnel in the world which has just been completed at Langley Field, Virginia. A full-size airplane is on the frame before it and a man stands in its throat to give a size comparison

actually obtained in flight. This is not altogether a disadvantage since the designers' estimates become more conservative thereby. It is, however, highly desirable, from a scientific point of view, to know exactly what this scale effect is. Therefore larger tunnels in which actual, full size airplanes can be tested have long been considered desirable. The sole difficulty in building such very large wind tunnels is the question of the financial expenditure involved.

The National Advisory Committee for Aeronautics, when the United States was still prosperous and no deficit faced the Treasury, was fortunate enough to secure adequate appropriations for the construction of a giant wind tunnel. This has just been completed. No official figures are available as to the cost of this tunnel, but it is understood that the cost ran well over a million dollars.

The tunnel is in the form of a huge, flattened out figure of eight. The working section of the tunnel is placed at the center of the figure of eight, where there is a break in the walls of the channel. The air flows past this break in the walls without any deviation, the entrance cone and the exit cone from the working section being carefully designed to this end. The actual working section—the section where the airplane is to be tested—is 30 feet high and 60 feet wide, so that an average full-size airplane can be tested.

The air is drawn past the working section by two large propellers, each 34 feet in diameter, and each driven by a 4000 horsepower electric motor. The air drawn past the propellers is then carefully guided past vanes, flows back in the return channels (which are the top and the bottom respectively of the giant figure of eight) and is then again guided back into the central part of the tunnel. With the propellers working at full power, a maximum air speed of 115 miles per hour is produced in the working section.

The airplane to be tested is placed on a floating platform, and supported aloft by hinged tubular struts. These struts transmit forces to six balances placed below, so that the three forces: lift, drag, and transverse, and the three moments: pitching, rolling, and yawing or turning are automatically measured or weighed on the balances. All measurements are simultaneous and a marked card emerges from each balance, not unlike in principle to the weighing machine ticket offered in our drug stores!

The tunnel was officially opened recently at Langley Field, at a ceremony attended by leaders of the aviation industry, and representatives of government aviation departments. The tunnel was so huge that the audience was awed; the impression was similar to that produced by a cathedral. One aircraft constructor expressed the general feeling very aptly: "I don't believe it. They do it all with mirrors."

The new wind tunnel will not displace all other tunnels; it will merely extend and clarify their results. Nor will it replace actual full flight testing. But it will be a marvellous instrument for research.

The scientific pilot will clamber aboard on a long, movable ladder, give the signal for the starting of the tunnel propellers, press a button and start his own engine. Then he will be actually flying. The huge platform will be pitched or turned at will, and accurate observations under conditions simulating actual flight will be quickly and readily made.—*A. K.*

Plane Types in Army Maneuvers

THE dramatic maneuvers through the mid-west and the east of the Army's First Provisional Air Division, composed of 672 planes, were carried out successfully in May with no serious accident to any pilot

Using the new test kit for investigating airplane performance, described on the opposite page

or plane. The plane-miles flown totalic well over 3,000,000.

The 672 planes participating in thes maneuvers were divided into the followin types and makes:

Bombardment:	10 Curtiss Condors
	34 Keystone Bombers
Light Bombardment:	36 Douglas BT
Attack:	70 Curtiss A-3
Observation:	142 Douglas Observation
	63 Curtiss Falcons
	60 Thomas-Morse Observation
Transport Group:	23 Fokker Transports
	11 Ford Transports
	5 Douglas Transports
	4 Sikorsky Transports
	2 Northrop Transports
Photographic:	2 Fairchild
Total	672

Engines used to power the 672 planes are divided into types and makes as follows:

Pratt & Whitney Wasp	289
Pratt & Whitney Hornet	119
Curtiss Conqueror and D-12	214
Wright Whirlwind J-6	45
Wright Cyclone	16
Liberty	81
Curtiss Hex	1
Total	765

New Oil-less Bearing Material

PRACTICALLY all so-called "oil-less" metal bearings are mounted without oil or grease in motors which turn only a few revolutions, and then are idle for a considerable time. Automobile starting motors consume most of the output.

A new self-lubricating bearing metal re-

cently developed can also be used with lubricant instead of the present oil-requiring bearing materials. If the supply, or film, of lubricant should for any reason become inadequate, this new bearing metal is capable of resisting the heating action of friction for a considerable length of time, by means of its own lubricating qualities.

This new bearing metal is the result of countless tests to determine what materials reduce friction most. When these were discovered, it was found that they could not be incorporated in an oil. Therefore, they were put in the bearing itself—right where they are needed.

The bearing is made by mixing one or more metallic powders with one or more materials yielding a soapy substance. The ingredients are put in a cold mold and subjected to a pressure of approximately 40,000 pounds per square inch. The temperature is gradually raised until it reaches about 400 degrees Fahrenheit—nearly twice that required to boil water. After keeping the mold at this temperature for half an hour, the pressure is raised to 200,000 pounds per square inch. The pressure is then released and the mold allowed to cool. The bearing is then removed from the mold.

Bearings made of this new material can either be made to certain specifications, according to the mold used, or they can be made in blank and machined to the size desired.—*A. E. B.*

The Mechanism of Swallowing

FOR many years physiologists have studied the mechanism of swallowing. As pointed out by A. E. Barclay, once swallowing has started, the human being has no control over the mechanism. We can swallow lying on the back, on the face, or even upside down, but, regardless of the position, once the act is started it is impossible to stop. For this reason numerous accidents occur, such as the swallowing of safety pins or other unusual objects which happen to get into the mouth.

The modern science of radiology has made it possible to watch the entire act of swallowing from the moment the material touches the tongue until it passes into the stomach. It takes a solid substance a half second to make the route and a liquid can do it in a quarter of a second. The sequence of events as now established by the use of the X ray is another demonstration of the intricacy as well as the enormous mechanical efficiency of the human body. As an example of what happens when things go wrong, Doctor Barclay cites the difficulty of having mucus stick just below the nasal pharynx. It is at a point just too low to be dislodged by sniffing and just too high to be swallowed. No matter how hard we swallow or how hard we sniffle nothing happens, until, by purely mechanical action, the mucus reaches a point where suction can be exerted on it from either above or below.

In the hydrator, automatically weighed batches of quick lime are treated with exactly enough water to hydrate the lime in the process for making lime from oyster shells

The phases of swallowing, as outlined by Doctor Barclay, include closing of the nose and mouth, raising of the larynx and obliteration of its upper part by the tongue, obliteration of the pharynx by raising the larynx and retracting the tongue, opening of the pharynx with the closing of three outlets, whereby negative pressure is established. This is established by dropping the larynx and allowing the tongue to go forward. In this position the food is passed over the back of the tongue, sucked into the mouth of the larynx which, after it receives the food, drops down to its normal position, thus opening up the wind pipe again after the food has passed. The entire mechanism is controlled by nervous impulses which establish conditions of motion, negative pressure, and suction, and which produce a prompt and continuous movement of the material from the mouth to the stomach.—*M. F.*

New Process for Removing Gases

A NEW process for removing the acidic gases, hydrogen sulfide and sulfur dioxide, from gases, which will create tremendous savings for the petroleum industry and the natural and manufactured gas industries, was announced at a recent meeting of the American Chemical Society. The process, the invention of R. R. Bottoms, director of research for the Girdler Corporation and a recognized authority on the purification and liquefaction of gases, employs triethanolamine, a new type of chemical reagent of such high absorption capacity that small mechanical equipment is required. According to Dr. Bottoms, the suitability of triethanolamine for such a purpose has been definitely settled through the experience of the Helium Company in the operation of its carbon dioxide removal system at Thatcher, Colorado.—*A. E. B.*

Pure Lime from Oyster Shells

A FLOURISHING industry that uses oyster shells as its raw material and produces an exceptionally pure grade of lime is described by J. B. Nealey in a recent issue of *Chemical and Metallurgical Engineering*. Ordinary commercial lime, such as used by contractors, is made by "burning" limestone, which, chemically speaking, is calcium carbonate. The chemical industries which use lime as a reagent demand a purer product and it was because oyster shells are almost pure calcium carbonate that this industry sprang up to supply the demand for "chemical lime." This plant, the only one of the kind in the world, is operated by the Haden Lime Company of Houston, Texas.

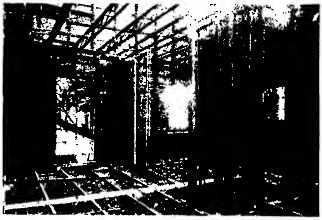
Shells to be made into lime are washed to remove silt, and crushed to a uniform size. They are then fed into gas-fired rotary kilns where they are heated to 2400° Fahrenheit. The kiln is 125 feet long, rotating at one revolution per minute so that a batch of shells passes through in about two and one quarter hours. Burned lime drops from the discharge end of the kiln into a pit whence it is elevated by bucket conveyors to a cooler. After the lime has cooled it is carried to a great steel hopper,

Clean oyster shells are fed into the firing end of the rotary gas-fired kiln shown with its gas and air piping, and temperature control at the right. The kiln is 125 feet long

Hot lime from the kiln is automatically and correctly cooled before going to the bins. This rotary cooler, 60 feet long and six feet in diameter, is fed from a bucket conveyor

of 22,000 cubic feet capacity. Mechanical "feeders" remove lime from this hopper and transport it to hydrators where it is mixed with exactly the right quantity of water to "hydrate" the burned lime. This hydration yields a white powder which must then be pulverized to insure uniformity in particle size, after which the product is ready for the storage bins and the automatic bagging machines. The hydrated lime from this plant is so fine that over 98 percent will pass through a 325-mesh screen.—*A. E. B.*

Building a two-story, six-room dwelling of arc-welded steel frame-work. A frame panel being welded to a sill



Interior view of the welded frame house showing floor joists, partition panels, and Steeltex backing of walls

A Welded Dwelling House

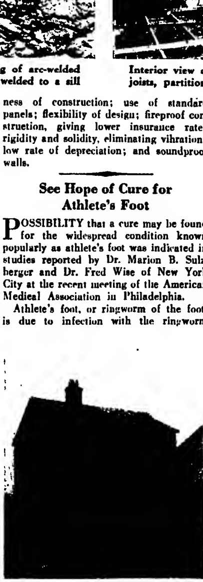
WHAT is probably the first completely welded brick and steel dwelling constructed by electric arc welding was recently built for and is now being occupied by C. E. Anthony of Larchmont Gardens, New York. It is a six-room, two-story building, 32 feet by 26 feet, with full basement and a two-car basement garage, and is built on a foundation of stone and concrete.

The entire framework and all interior partitions were made up of standard size panel frames previously fabricated in the welding shop from 1½-inch angles. The fabricated panels were then welded to a plate sill, and adjoining panels were welded together at their edges to make a solid structure throughout. The second floor was erected in exactly the same manner and was welded to the top of the first floor sections. Electric current for all field welding was generated by a General Electric gasoline engine-driven arc welding set.

Steeltex, a two-inch wire mesh spot welded at each juncture and interwoven with fire-resisting, waterproof paper, was laid directly over the floor joists and covered with a two-inch course of concrete to make up the floor. The roof covering consists of Steeltex placed directly over four-inch channel rafters and covered with a two-inch layer of Nailcrete, a concrete asbestos composition of such characteristics that nails can be driven into it for laying shingles. A layer of slate shingles was used.

The outside of the house is finished off with a brick veneer, inside which is placed a layer of Steeltex, to the top of the second floor level. The gables and dormer are finished with stucco. The interior finish of the house consists of Steeltex over the framework, and hard plaster. The floors are covered with Armstrong inlaid linoleum with a felt backing on both the first and second floors. The stairways are steel with ornamental iron railings, welded in place, and have Sutterlith treads—a composition of plaster of Paris, cement, and sawdust. All baseboards are also made of this material.

Many advantages are claimed for the welded type of construction, among them being the following: rapidity and noiselessness of construction; use of standard panels; flexibility of design; fireproof construction, giving lower insurance rate; rigidity and solidity, eliminating vibration; low rate of depreciation; and soundproof walls.



The completed dwelling with frame made up of welded steel panels

See Hope of Cure for Athlete's Foot

POSSIBILITY that a cure may be found for the widespread condition known popularly as athlete's foot was indicated in studies reported by Dr. Marion B. Sulzberger and Dr. Fred Wise of New York City at the recent meeting of the American Medical Association in Philadelphia.

Athlete's foot, or ringworm of the foot, is due to infection with the ringworm organism, which is a fungus. Both the number and severity of cases are increasing to an alarming extent. Besides the original condition of the foot, secondary skin eruptions may develop. These secondary eruptions are believed to be caused by a special sensitiveness to the ringworm organism which is distributed through the blood stream. The secondary eruptions are called dermatophytids, while the primary foci of infection are known medically as dermatophytoses. The dermatophytids, curiously enough, do not contain the actual organisms causing the trouble.

Other organs besides the skin can become sensitive, Drs. Sulzberger and Wise stated. They believe that this sensitiveness to fungi may be the cause of otherwise inexplicable cases of hay fever and asthma.

Drs. Sulzberger and Wise attempted to de-sensitize a number of patients by injections of trichophytin, a vaccine made from the fungus that causes the disease, the trichophyton. Of 18 patients treated, 15 were either wholly or partially de-sensitized and 10 seemed benefited by the treatment, showing either freedom from the trouble for a relatively long time, marked improvement, or apparent cure. General use of the method is not justified from the results in this small number of cases, but the study gives rise to the hope that this annoying condition may be controlled.

At the same session, four cases in which persons who had ringworm in their feet or elsewhere and developed sensitiveness to other substances as a result of the sensitive condition of their skin were described by Dr. Cleveland White and Dr. Samuel J. Taub of Chicago.

Cottonseed oil, buckwheat, oatmeal, and silk were found to be the offending substances respectively in each of four young women who consulted these physicians for skin eruptions. Three of them eliminated the offending foods from their diet and the fourth stopped wearing silk, whereupon they all recovered.

A strange feature of the cases was that none of the patients had had any such disturbance before they acquired the ringworm infection. From this fact, the physicians concluded that in some people who have fungus infections the skin is so altered that it becomes sensitive to certain foods or external irritants.—*Science Service.*

New Chemical from Apple Peels

URSOLIC acid, a new chemical that appears to have promising possibilities for commercial use, is being extracted from the waxlike coating of apple peels in a laboratory of the United States Department of Agriculture. Dr. Charles E. Sando, of the Bureau of Chemistry and Soils, who for many years has been investigating the chemical nature of the surface coating of apples, perfected the method for extracting

the compound, in the form of a powder, from apple pomace. Recently he has sent samples to several commercial concerns for study by their research departments.

Perhaps the most promising use for this new chemical is in the paint and varnish industry. The fact that the powder is resinous to the touch and is water repellant suggested its use in varnishes. Preliminary tests made by the American Paint and

The steel tape of the Ree-Koil starter winds itself for the next pull

Varnish Manufacturers' Association show that ursolic acid increases the gloss and water resistance of cellulose lacquers.

Another effect of adding small amounts of ursolic acid to lacquers is to extend the time required for drying. This seemed to improve the brushing qualities of the lacquers so treated, especially for the first coat.

Doctor Sando has found that apples differ with respect to the amount of waxlike substance found on their surface at harvesting time. Arkansas Black, Delicious, and Grimes Golden contain relatively large quantities of ursolic acid, while Yellow Transparent, Rhode Island Greening, and York Imperial have much smaller amounts.

If there is sufficient demand it would be possible to produce 500,000 pounds of ursolic acid in this country annually, it is estimated. The principal sources would be wastes from canning plants, skins left from dehydration of apples, and from apple pomace, the residue produced in the manufacture of cider and vinegar.

Outboard Motor Starters

ON the new Johnson Ree-Koil starter, a steel tape which automatically winds itself into its container in readiness for the next pull as soon as it is released, replaces the conventional rope starter.

The operator grips the handle, pulls once, twice, until the motor starts. When the handle is released the steel tape winds back into starting position for the next pull.

The new starter is of such simple construction that it is estimated it will last, without any service necessities, for the lifetime of the motor. It has been released as standard equipment for Sea-Horse Models 4, 12, 16, 24, 32, and racing motors.

Another starter which operates on the inertia principle and which may be easily installed on any outboard motor, has been developed by the Eclipse Aviation Corporation, East Orange, New Jersey. The manufacturers claim that, with this starter, a child can start even the largest outboard motor with ease.

To operate the Eclipse starter, a small detachable hand crank is applied to a spindle at the top. This crank is easily and gradually revolved until a small, light weight fly-wheel contained within the starter is brought, through gearing, up to a very high speed.

Usually not more than 10 seconds maximum is required to bring the fly-wheel up to normal speed. When it is revolving fast enough, the operator ceases cranking, the hand crank is automatically detached, and a large button is disclosed which, when pressed, engages the starter with the engine. The enormous energy stored in the rapidly revolving fly-wheel is thus utilized to crank the engine.

The starter cranks the engine at an initial speed of 750 revolutions per minute or higher. This cranking speed ensures positive starting under the most adverse conditions. Generally speaking, (allowing for different engine sizes and characteristics) the engine is turned over about 20 to 25 revolutions. To absorb stresses which may occur should the engine back-fire, a built-in clutch protects both starter and engine against damage.

"Hand Raised" Parasites Destroy Range Pests

MILLIONS of small wasplike insects are now being liberated on the cattle ranges of the southwest to destroy the eggs of the range caterpillar, a pest which, after having been comparatively inactive there for 10 years, threatens to eat up all the range grass over a wide area.

In the 1914 outbreak nature provided the parasites to control the range pest. This year entomologists of the United States Department of Agriculture are providing them to help nature renew the supply that has almost entirely disappeared from the region.

To be ready for the coming of the caterpillars, Government entomologists through the winter produced the parasites at the rate of 60,000 a day and placed them in cold storage at the Tempe, Arizona, field station. The vast insect army is now being deployed over the grazing grounds where the range caterpillar is present in the egg stage in large numbers. The tiny parasites will at once attack the caterpillar eggs and, it is hoped, quickly reduce the number of caterpillars to normal.

Similar parasites are being tried against many insect pests, including the alfalfa weevil, codling moth, oriental fruit worm, and the corn borer, but this is the first time they have been tried on a large scale against the range caterpillar.

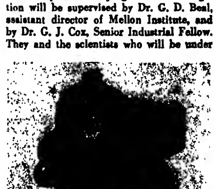
"Range caterpillars," says Dr. W. H. Larrimer, in charge of the Department of Agriculture's work on cereal and forage insects, "are such greedy and wasteful feeders that sometimes they seem to eat from habit rather than from hunger. They destroy the range not only by chewing the grass down to the roots, but also by covering any uneaten blades with shed skins and poisonous spines, thus spoiling the pasture for the stock. Recently this pest, long familiar on ranges and pastures, has added cultivated crops to its diet."

New Lubricant Made from Paraffin

PARAFFIN wax, formerly a troublesome by-product of petroleum distillation, has just been converted into a superior grade of lubricating oil, according to a statement just made by a member of the petroleum research committee of the Society of Automotive Engineers. While it has been known for some time that the molecules of the ideal lubricant were made up of two hydrogen atoms and one carbon atom, it has remained for a chemist of the Standard Oil Company of Indiana to produce a synthetic lubricating oil having this ideal structure. In the natural oils it has been very difficult and expensive to secure such "olefines" but new methods of modern research have revealed a way to crack paraffin and secure an oil of pale straw color, highly resistant to oxidation and capable of standing up under high temperature. Engineers explain that the viscosity can be easily controlled and that therefore this oil is well suited for severe service at either thickening low temperatures or thinning high temperatures.

Investigate Industrial Uses for Sugar

DR. E. R. WEIDLEIN, director of the Mellon Institute of Industrial Research, has announced that the institution has lately begun a broad investigation into possible industrial uses for raw and refined sugar. The research will be carried on by a multiple Industrial Fellowship that will be sustained by the Sugar Institute, Inc., of New York, an organization that represents the cane-sugar refiners of the United States. The comprehensive program of investigation will be supervised by Dr. G. D. Beal, assistant director of Mellon Institute, and by Dr. G. J. Cox, Senior Industrial Fellow. They and the scientists who will be under



When the inertia starter is cranked, it starts the motor without effort

their direction in endeavoring to find and to develop uses for sugar in various industries will have the close advisory collaboration of Dr. L. H. Cretcher, the sugar specialist, who is the head of Mellon Institute's department of research in pure chemistry.

According to Dr. Weidlein, various studies made by private research workers have already indicated results of industrial promise; these findings will be carefully studied in the laboratories of the Mellon Institute. Most of these proposals relate to applications for sugar in such technological

operations as wood preservation, textile finishing, and the manufacture of adhesives. Sugar is thought to merit searching investigation as a basic raw material for employment in various branches of chemical industry. Four chemists, headed by Dr. Cox, have begun the initial scientific research of the Industrial Fellowship. Additions will be made to this staff, as needed, from time to time.—*A. E. B.*

Heat-Resistant Truck Inner Tube

DEVELOPMENT of a new product in the rubber industry has just been completed, it is indicated in the announcement by the General Tire and Rubber Company that its engineers have just perfected a new black tube for truck tires.

"Use of a new heat-resisting compound gives the new black tube its principal point of superiority over the ordinary tubes now in use for truck tire casings throughout the country," says Charles J. Jahant, vice-president of the company, in charge of production.

"Internally-generated heat is the principal enemy and destroyer of truck tire tubes. This new black tube has proved that it is able to resist this heat to a degree not previously thought possible. In tests, sections of the best red molded tubes, of leading makes, were spliced to sections of the new black tubes. Then they were run on test trucks until the tubes failed. In every case, the red half of the tube crystallized and went to pieces, while the black half remained intact, flexible, elastic, and practically as good as new. The pieces of the red sections, which broke into small bits, were brittle and lifeless and could be pulled apart with thumb and finger."

The accompanying picture shows the result of one of the tests described above, with the red tube sections in pieces and the black tube section intact.

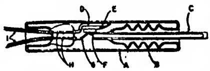
An Electrical Hair Trigger

A NEW vacuum contact for use wherever a positive rapid and durable electrical contact is needed in circuits handling up to six amperes continuous load or eight amperes intermittently, at potentials up to 220 volts, has recently been placed on the market. It can be operated by hand, by mechanical means, or by an electromagnetic agency in conjunction with a telephone type relay. This contact is especially well adapted for use in telegraph and telephone circuits, for railway switches and signals, for fire and burglar alarm systems, controllers, advertising signs, rectifiers, electric ranges, and other applications where a considerable wattage must be controlled by a minimum of energy. It operates in any position and is unaffected by movement or shaking.

[illegible] to an ordinary tube, the new truck tire tube resists heat while the

The accompanying diagram presents the operating details of the vacuum contact. It will be noted that the principle is extremely simple. It makes use of the elastic property of glass to cause the mechanical actuation of contacts sealed in vacuum. The bellows *B*, because of their shape and the tempering of the glass, are highly elastic. A slight movement of the stem or protruding rod *C* is communicated to the movable contact block *E*, causing it to separate from contact block *G* which is stationary. The spring *E* makes positive contact between the contacts when no pressure is applied to the stem. The contacts are maintained in the evacuated glass tube *A*. The leads are indicated at *I*.

The vacuum contact is a development of Siemens & Halske of Germany and has met with wide application in that country as well as in Great Britain. It is now being introduced in the United States by the



The electrical hair trigger which is explained in the text herewith

Burgess Battery Company of New York and Chicago.

Operating in a vacuum, the vacuum contact is free from serious arcing and corroded contacts. It can handle its rated current as fast as 40 breaks per second. The make and break are positive and clean, without the bang-overs and chattering experienced with other forms of contacts, as proved by comparative oscillograph recordings. The vacuum contact requires a movement of only 0.02 of an inch at the end of its stem, which can be brought about by a force of less than 10 ounces, and usually but 6 ounces. The temperature rise at the rated current is extremely slight. The circuit is broken without arcing at less than 0.001 of an inch separation of the contact blocks. The small movement and slight force required for operation lowers the total cost by the elimination of mechanical links. As for life, one of these contacts has been operated, at a rate of 10 times per second, 124,000,000 times without breakdown.

Paraffin Saves Bananas from Decay

BANANAS can be saved from one of their most costly types of spoilage by the simple trick of anointing the cut end of the stalk with paraffin. This discovery has been made as the result of a joint research conducted at Cambridge, England, by R. C. Tompkins of the Low Temperature Station and Dr. R. M. Woodman of the School of Agriculture.

One of the most serious causes of spoilage

The delicate little tube which controls powerful electrical circuits

in bananas is rotting which spreads from the cut stalk. Molds grow where the stalk is cut and cause rot. If the mold growth in the cut stalk could be prevented, this form of spoilage would disappear. The same type of rot is also found in pineapples and melons.

Mr. Tompkins and Dr. Woodman treated the cut stalks of bananas with a number of substances to see whether mold growth could be prevented in this way. Fungicides proved to be practically useless. Borax, copper sulfate, corrosive sublimate, formaldehyde, and potassium permanganate, all of which usually destroy fungi, were not able to prevent the rot of bananas.

Excellent results were obtained, however, with substances which block the surface of the cut stalk mechanically. Thus there was no subsequent rotting if the banana ends were dipped in melted paraffin wax. The rotting was also considerably reduced when the banana ends were smeared with vaseline.—*Science Service.*

Ultra-Violet Protective Paint

AN improved paint for protection from ultra-violet radiation has been announced by the General Electric Company. Developed particularly to absorb the dangerous invisible rays of ultra-violet light produced in arc welding, the paint is used on the walls and ceilings of rooms in which electric arc welding equipment is being used. Better adhesion and no tendency to powder off the surface have been attained in this new, gray, oil-type paint. Petroleum spirits are used for thinning the paint, which dries in approximately two hours. —*A. E. B.*

Operation Saves Victims of Mercury Poisoning

AN operation which will save the lives of persons who have swallowed the deadly poison, bichloride of mercury, was described by Dr. Samuel Berger of Cleveland, at the meeting of the American Medical Association in Philadelphia recently.

The operation is called cecostomy and consists of an opening into the cecum, which is a sort of dilated pouch into which open the large and small intestine and the appendix.

Dr. Berger and associates, Drs. H. S. Applebaum and A. M. Young, examined carefully the bodies of persons who had died by poisoning with bichloride of

mercury. They found that gangrene developed in the lower intestine in a large percentage of patients who lived beyond the first 24 hours after swallowing the poison. This gangrene was responsible for the deaths of these patients.

The treatment which Dr. Berger and associates then instituted consisted of a constant flushing of the gastro-intestinal system with water through the opening made by the cecostomy operation. This flushing interrupts the passage of the poison from the colon to the stomach and averts the development of gangrene.

The procedure is only successful when performed within a few hours after the poison has been swallowed, Dr. Berger emphasized. Patients in whom it was carried out after two days or more all died. —*Science Service.*

Plane To Fly Six Miles High

AIRPLANES flying at heights of over six miles, which can reach much higher speeds than existing machines, are being constructed at the famous Junkers-werke at Dessau, Germany. Already the first airplane to be used for research in this work has been constructed with the assistance of the German Institute for Research in Air Communication and the scientific Notgemeinschaft. [See also page 127, February 1931 SCIENTIFIC AMERICAN. *Editor.*]

The mysterious guns of the German army, bombarding Paris at a distance of 75 miles, were the first practical application of the decidedly lower resistance of the "stratosphere," that tenuous layer of the atmosphere lying above a height of six miles. The chief aim of the new machine is to reach high altitudes and to find paths which can be used as regular airplane trade routes. It is not built for high speed or long flights, since it is regarded as an experimental laboratory for the study of the special conditions prevailing in the stratosphere. High speed can easily be attained at these heights. Recording rockets and balloons have been previously used to explore the stratosphere.

The airplane is a Junkers metal deep-deck, single-motored machine of 60-foot wing breadth and 9000 pounds weight. A small compressor keeps the air pressure normal for the men within the cabin, which is double-walled and air-tight. Control of the motor and steering is done by levers in the cabin working in air-tight shafts. The motor itself is of a special type and has an air pump to supply enough air from the thin air at these heights.

On the basis of experiments with this machine a new air pump will be designed for altitudes up to 10 miles. A large installation of scientific instruments forms the equipment.—*Science Service.*

Stronger Alloys Cast Under Pressure

EVIDENCE that alloys of improved quality may be obtained by casting them under pressure has been established by the experimental work of a German chemist, G. Welter. Alloys which usually are cast under atmospheric pressure have been subjected to hydrostatic pressure before their crystallization. Experiments were conducted under pressures from 500 gradually up to 20,000 atmospheres. Resultant improvements in the material were proportional to the increase in pressure. Silicon aluminum alloys had their tensile strength increased from 10 to 20 percent, and alloys hardened under high pressure in general showed a denser and less porous structure than those made by the normal methods.—*A. E. B.*

Micro-Movies for the Amateur

IN order to give the owner of a 16-millimeter motion picture camera the opportunity to make film records of micro-

Courtesy Bell and Howell

The outfit designed by Dr. Rosenberger for making micro-movies

scopic objects, such as the animal and plant life found in almost any drop of water, also bacteria, the flow of protoplasm in plant cells, micro-chemical experiments, and a host of other fascinating subjects, Dr. Heinz Rosenberger of the Rockefeller Institute for Medical Research has designed the simple outfit shown in an illustration herewith. Its essentials are the camera, a microscope, and a stand having a focusing and beam centering device. An eyepiece permits focusing and seeing the object as it is photographed.

Dr. Rosenberger is one of that comparatively small group of scientific workers who have one foot in pure science—in this case biology—and the other in refined mechanics and design. When the designer of refined apparatus is either a scientist alone, or a mechanic alone, the apparatus generally shows the deficiency; it is at best only "a square peg in a round hole," but when he is both, the apparatus also shows it—favorably. Dr. Rosenberger has also designed micro-cinematographic apparatus for professional biologists but this is vastly more complex and is scarcely known outside the special field it covers—though it is widely known within that field.

900,000-Volt X Rays

X RAYS at 900,000 volts, over four times as high a voltage as is being used in today's most powerful therapy tubes, have been attained by Dr. W. D. Coolidge, associate director of the General Electric research laboratory at Schenectady. Such a decided increase in voltage, and hence increase in penetrating power of the rays, was made possible by a system of "cascading" the tube, an arrangement devised by Dr. Coolidge in his work with high-voltage cathode-ray tubes.

The 900,000-volt X-ray tube, Dr. Coolidge said, is built in two sections. In his previous work in cathode-ray tube development it was found that tubes can be built for very high voltages by the use of a cascade (or sectional) system, and that by this method there appears to be no limit to the voltage which can be used. The target replaces the "window" of the cathode-ray tube so that, instead of cathode rays being emitted by the tube through such a "window," X rays of exceedingly high penetrability are generated by the impact of the electrons (or cathode rays) on the target.

By dividing tubes into sections, each of which may be good for as much as 300,000 volts, a three-section cathode-ray tube for 900,000 volts was constructed some years ago. Such a cascade or multi-sectional system, Dr. Coolidge found, promises to permit the building of vacuum discharge tubes for as high voltage as can be generated—and voltages of millions are being produced in the Pittsfield laboratory of the

900,000-volt X rays are obtained with this giant tube

General Electric Company. The use of the cascade tube applies equally well to X-ray and cathode-ray tubes, since the latter may be converted into the former by the addition of a suitable target.

The highest voltage Coolidge X-ray tubes used commercially at the present time are of 200,000 volts peak capacity, and are of two types—water-cooled and air-cooled. Both are adaptable for X-ray therapy. The air-cooled type has been used to considerable advantage in industrial applications of X rays, since the high voltage gives the necessary penetration required for examining the heavier metal objects. Industrially, higher voltages would permit radiography of thicker metals, and shorten times of exposures.

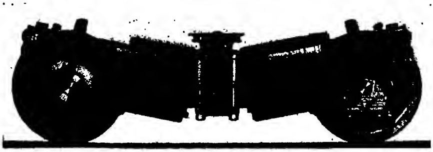
Quiet Street Car Truck

FIFTY thousand Detroiters crowded Woodward Avenue recently to celebrate the adoption of "quiet" street cars on the city's municipal system. In the parade that was featured were several of the 20 new cars recently ordered which are equipped with the noise-eliminating trucks.

The street car truck is a contribution of Detroit automobile experience in a new field of transportation. It has been developed by Nelson R. Brownyer and a staff of engineers of the Timken-Detroit Axle Company. They have applied many automobile features to the truck, particularly in lightening it, and in carrying most of the weight as "sprung" weight.

A reduction of 3400 pounds per truck has been effected. This has an important bearing on the question of track maintenance, a bugbear of city street railway systems. But the principal contribution of the new truck is its "quiet" operation. Sound tests made in Detroit and Chicago have indicated that the same car, equipped with these trucks, is 50 percent less noisy in straight running on smooth track and in going over switches and crossings, than the car equipped with present type trucks.

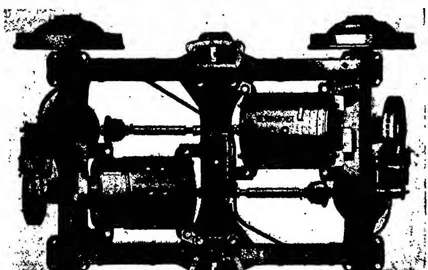
Worm gears eliminate gear noise completely. A new type of brake, developed out of automobile experience, can not make any noise in its operation. The brake is a disk applied to the end of the armature shaft of each motor. The 50 horsepower electric motors, the brake and the frame of the truck are carried as "sprung" weight, and only the dead weight of the wheels and axles has "unsprung" contact with the track. Long leaf automobile-type springs are used. The clattering and banging of an average car going over a "diamond" crossing is changed to a metallic thud as the wheels strike the joints. The ends of



Side view of the new quiet street car truck

the springs are mounted in rubber, and the general impression of a running car, whether on smooth or rough track or on crossings is that it is "light on its feet."

Members of noise abatement commissions in New York and Chicago, and the head of the public health committee of the Detroit Board of Commerce have heralded the truck as a distinct contribution to the health of city dwellers. Prominent street transportation officials from as far away as Seattle, showed their interest in the development by coming to Detroit for the one-day celebration.



Differentials, motors, and other features of the new street car truck

Silver, a Construction Material in Chemical Plants

RECENT changes in the economic position of silver and their influence on its price have caused chemical engineers to cease regarding silver as "bullion" and to consider its use as a material for the construction of plant equipment. Thus, pieces of apparatus weighing 300 to 400 pounds are being made from pure silver, most of them for handling acetic acid. Because of its resistance to attack by organic acids, silver is especially adapted for equipment used in the preparation of foodstuffs.

Silver and the precious metals frequently occur in ores in very small quantities, often little more than traces, but the metallurgical methods of today are such that all these small quantities are collected, and in the bulk represent a very respectable and increasing output. Therefore, according to Donald McDonald in a recent paper presented before the Society of Chemical Industry, large quantities of silver are coming automatically upon the market as by-products in the production of other metals, such as lead, copper, zinc, and nickel—metals for which there is sufficient continuous demand to insure the permanency of the operations concerned in their production.

In considering the use of silver as a material of construction, it is necessary to deal with a phenomenon which is capable of affecting some of the physical properties of the metal, and which is so peculiar as to be almost unique in commercial metallurgy. This is the power of absorbing large quantities of oxygen when in the molten state—most, but not all, of which it disengages on solidification. Thus, in casting silver, the dissolved oxygen is apt to cause blowholes. Further, as a certain amount of gas remains in solution even after solidification, the physical properties of the specimen are bound to vary somewhat with the casting conditions and the extent or efficacy of any previous deoxidation treatment. Such deoxidation enables sound castings to be produced by experienced hands. A layer of charcoal on the surface of the molten metal for a few minutes before pouring is enough for most practical purposes.

Silver is the best conductor of heat and electricity of all the metals. It resists attack by caustic alkalies. Sulfuric acid does not attack it appreciably at room temperature unless some oxidizing agent is present. Chlorine attacks it, forming silver chloride, but strangely enough, this insoluble silver chloride forms a very hard, impervious coating on the silver, which protects it from further attack.

The most extensive application to chemical plants evident so far is in the condensation and general handling of acetic acid, which is particularly corrosive at the moment of condensation. Because of its superior thermal properties, a silver condenser can be considerably smaller than a copper one designed to do the same work. The use of silver is spreading to the food industries. In the distilled vinegar industry the use of copper, even when tinned, has not yielded universally satisfactory results, and trouble has occurred when the vinegar made in it is employed as a pickling medi-

(Please turn to page 136)

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

TENDENCIES IN LIGHTING PRACTICE 1930 by A. L. Powell, describes and illustrates some of the latest developments in lighting. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio. —Gratis.*

BIBLIOGRAPHY OF AERONAUTICS, 1929 (National Advisory Committee for Aeronautics) is a valuable book of reference. *Superintendent of Documents, Washington, D. C.—25 cents (money order).*

ASTRONOMY MADE EASY is a 119 page booklet originally designed as a companion to the celestial globe. Contains much real astronomical lore, in addition to a survey of the heavens. *Rand McNally and Company, 536 South Clark St., Chicago.—One dollar.*

RECOMMENDED MINIMUM REQUIREMENTS FOR FIRE RESISTANCE IN BUILDINGS (Building and Housing, No. 14, Bureau of Standards) is a report of the Department of Commerce Building Code Committee. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

WILD DUCK FOODS OF NORTH DAKOTA LAKES (Technical Bulletin No. 221, U. S. Department of Agriculture) by Franklin P. Metcalf, gives the result of detailed studies of 500 lakes. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

THE OBSTACLES AND PITFALLS OF INVENTORS by Joseph Rossman, Ph.D., deals with an interesting phase of invention. It is a complete chapter from Dr. Rossman's new book "The Psychology of the Inventor." *The Inventor's Publishing Company, 1266 New Hampshire Ave., Washington, D. C.—Gratis.*

ON THE ART OF METALLOGRAPHY (Technical Publication No. 421, The American Institute of Mining and Metallurgical Engineers) by Francis F. Lucas gives his Howe Memorial Lecture and supplies valuable information on the structure of metals. There is a beautifully executed colored plate. *The American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City.—36 cents.*

YEARBOOK OF THE CARNEGIE INSTITUTION OF WASHINGTON, 1930. A 438-page account of the large amount of research in biology, chemistry, astronomy, genetics, geophysics, terrestrial magnetism, nutrition, physics, physiology, seismology, and other sciences, performed during one year by the many branches of the Institution. *Carnegie Institution of Washington, Washington, D. C.—One dollar.*

THE PHARMACOLOGY OF THALLIUM AND ITS USE IN RODENT CONTROL. (U.S. Dept. of Agriculture Technical Bulletin 238). Thallium, though too dangerous for general use, is suitable where highly resistant rodents require extermination. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

BROWN POTENTIOMETER PYROMETERS (Catalogue No. 1101, Brown Instrument Co.) describes the very latest developments in these instruments which have very wide industrial uses. *Sent to executives by the Brown Instrument Company, Philadelphia, Pa.—Gratis.*

EMULSIONS, THEORY AND PRACTICE WITH ACTUAL WORKING FORMULAE describes seven new emulsifying preparations. *Glyco Products Co. Inc. Bush Terminal Building, No. 5, Brooklyn, N. Y.—Gratis.*

LUBRICATING OPEN GEARS gives a tested formula in detail. The leaflet may be obtained from the *Link Belt Company, Chicago, Ill.—Gratis.*

THE MELLON INSTITUTE AND THE AWARD OF THE AMERICAN INSTITUTE OF CHEMISTS' MEDAL TO MESSRS. ANDREW AND RICHARD MELLON (*The Chemist*, Vol. VIII. No. 7) describes both the old and the new building of the Mellon Institute as well as awards to the Field-Marshals of American finance and industry—the Mellon Brothers. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

THE QUARTER-HORSEPOWER PORTABLE MOTOR ON THE FARM (Report No. 3, April 1931, National Rural Electric Project) describes the uses, installation costs, and so on of small farm portable motors. This is one of a series of leaflets which can be obtained from the *National Rural Electric Project, College Park, Md.—Gratis.*

A LIST OF THE BOOKS, BULLETINS, JOURNAL CONTRIBUTIONS AND PATENTS BY MEMBERS OF MELLON INSTITUTE OF INDUSTRIAL RESEARCH DURING THE CALENDAR YEAR 1930 (Bibliographic Series, Fourth Supplement to Bulletin No. 2) by Lois Heaton Pugsley lists the achievements of the members who are conducting research work at that splendid institution. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

THE EFFECT OF SMELTER ATMOSPHERES ON THE QUALITY OF ENAMELS FOR SHEET STEEL (University of Illinois Bulletin Vol. XXVIII. No. 82, Bulletin No. 224, Engineering Experiment Station) by Andrew I. Andrews and Emanuel A. Hertzell, deals with a highly technical subject of considerable importance. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—10 cents.*

PSYCHOLOGICAL PRINCIPLES IN AUTOMOTIVE DRIVING (Contributions in Psychology No. 11, the Ohio State University Studies) by Albert P. Weiss, Ph.D. and Alvhh R. Lauer, Ph.D. analyzes the visual factors involved in automotive driving. Special apparatus was designed for use in the studies. *The Ohio State University, Columbus, Ohio.—$1.50.*

A FIELD KEY TO THE GENERA OF WILD AND CULTIVATED HARDY TREES OF THE NORTHEASTERN UNITED STATES AND CANADA by Mary Franklin Barrett describes a system for finding the names of trees by means of characteristics possessed by their leaves, stems, and winter buds. *Mary Franklin Barrett, 64 Park Ave., Bloomfield, N. J.—35 cents.*

LABORATORY TESTS OF REINFORCED CONCRETE ARCHES WITH DECKS (University of Illinois Bulletin Vol. XXVIII. No. 34—Bulletin No. 226 Engineering Experiment Station) by Wilbur M. Wilson, describes interesting tests with specially designed machinery. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—50 cents.*

RESEARCH SERVICE FOR INDUSTRY (Engineering Research Circular No. 5, Department of Engineering Research, University of Michigan, Ann Arbor, Mich.) describes the splendid facilities for research which this institution affords. It is profusely illustrated. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—Gratis.*

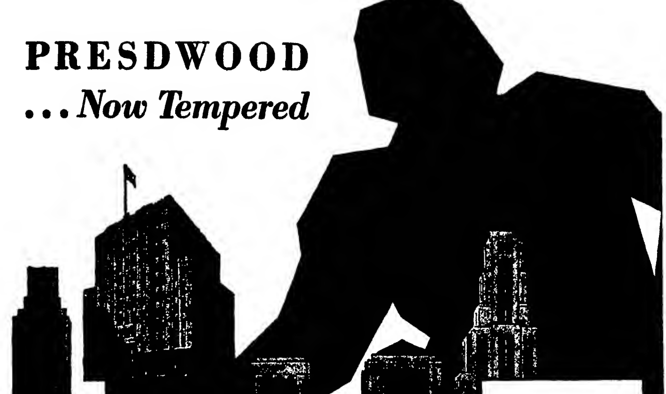
STANDARD THICKNESSES, WEIGHTS AND TOLERANCES OF SHEET METAL (Circular of the Bureau of Standards No. 391) gives a series of valuable tables indicating customary practice. *Superintendent of Documents, Washington, D. C.—[illegible] cents (coin).*

THE USE OF COLLOIDAL GRAPHITE IN THE MANUFACTURE OF RESISTANCES describes the ability of colloidal-graphited water to form tenacious conducting films on paper, glass, and so forth, and is extensively utilized in the manufacture of certain types of electrical resistances, particularly in radio work. *Acheson Oildag Co., 664 Madison Ave., New York City.—Gratis.*

CARE AND REPAIR OF THE HOUSE, Building and Housing Publication BH15 of the Bureau of Standards, gives practical instructions for all kinds of jobs—some of them rather intricate—for which householders ordinarily are forced to call in the plumber, carpenter, electrician, and others. For example, waterproofing a wet cellar; insulating a heating system, and so on. *Superintendent of Documents, Washington, D. C.—20 cents (money order).*

PRESDWOOD

. . . *Now Tempered*



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The St. Louis University's School of Commerce & Finance. Gillespie & Daley, contractors, used 60,000 sq. ft. 1/4" Presdwood as concrete forms for 150,000 sq. ft. area, producing smooth surface concrete of notable strength. The 3' x 12' pans permitted saving in concrete due to their size

With the Presdwood forms, there was a reduction in size and quantity of lumber used. Shoring was used under beams only; no re-shoring required. Quick erection and stripping helped to reduce cost

Note the smooth surface of the concrete—no grinding, extra finishing or plastering required. After being stripped, the Presdwood used was

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THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THE Sixth Annual Convention of amateur telescope enthusiasts will be held at Stellafane, near Springfield, southeastern Vermont, Saturday, July 25. This is probably the only invitation that will be issued, as the Springfield people tell us that the number of enthusiasts has now increased past their power to mail individual announcements, but that the latch-string hangs just as far out as it always has and always will.

Electricity grinds, Graves watches

These wholly informal gatherings usually attract several hundred amateur telescope makers and users, men, women and children, and a drive to Stellafane makes an interesting week-end. Come in your old clothes, or if you haven't that much this sad year, come anyway. If you camp, bring along your camp outfit—there's plenty of room—and if you don't, there's a hotel in the village.

AS WAS stated explicitly in "Amateur Telescope Making," (the instruction book from which the many telescopes described from month to month in this department of the magazine were made) most workers make the concave mirrors of their reflecting telescopes by hand, and this method has no drawbacks except to the lazy. But if one wishes to do it with a machine and actually enjoys concocting a machine—in other words, if the worker is possessed of the true mechanical instinct—then a machine is the thing to have and one need make no apology for it. One of the more serious addicts of the telescope making hobby, Mr. Byron L. Graves of Los Angeles (336 South June Street) has made such a machine, essentially the Porter type shown at B, Figure 3, page 151 of "Amateur Telescope Making."

Mr. Graves, who was formerly with the Ford Motor Company and later had much to do with airplane development in California, obtained suggestions and help directly from Mr. Porter in nearby Pasadena. Later at our request he described his fun in the following letters:

"With the new edition of 'Amateur Telescope Making' in one hand and a saw in the other, I built a bench and mounted on it the Porter grinder and polisher, assembled out of old parts picked up around junk piles—with the exception of the gears, which are standard stock Boston, as well as the mounts for the bearings. You are mistaken; the grinder is not an engineer's job. I know little or nothing about engineering, having been engaged in the Ford assembling and selling business—operating Ford branches—for 19 years previous to 1926.

"I had the good fortune to meet the back-yard astronomer's friend, Mr. Russell W. Porter, who is busy on the big 200-inch job over at 'Cal Tech,' but not too busy to talk to an amateur telescope maker. He told me the proper speed to use on the machine, namely 4 r.p.m. for the main table (revolving) on which rests the tool, and 1 or 2 r.p.m. for the mirror disk (in the opposite direction). The stroke speed is regulated for about 45 per minute. Any length stroke may be had by simply sliding the crank pin on the old Barnes face plate, in or out. In grinding I speeded up to 55, with corresponding increase of speed in table and mirror. When it came to final polishing I used a weight to balance the load so that the mirror just about touched the tool.

"I got pretty well discouraged once or twice when I overshot the mark and missed the parabola by about half an inch. I don't know when I have spent as many pleasant evenings as I have had grinding and polishing and figuring my little six-inch mirror. The results? Well, I can count the braces on the big tower at the Mount Wilson Observatory from my back yard—over 20 miles away. My stars don't have tails on them, either, and they have a dark spot in the center under focus and the same over. I never had seen another reflecting telescope or speculum, so that Irish preacher Ellison did a pretty good job of instructing by book. By the way, if that fellow lived on this side of the Atlantic I would join his church and attend every Sunday morning. For, if he can preach as well as he describes this telescope thing, I wouldn't care what religion he put out. He told just one lie in the whole book, namely, the time he takes to make a six-inch speculum from start to finish."

Some months after receiving the above letter, Mr. Graves was asked how he was making out. This is what he replied:

"I've been so busy on this new hobby that I have neglected my home and family, to say nothing of business affairs. Porter came over from Pasadena and gave my first attempt the 'once over'. He said she looked O.K. but of course the mirror didn't amount to much—I think he said she had spherical adenoids due to too tight lacing. I loosened her up and she now shows a round image of a star in or out of focus.

"The enclosed photograph will give you some idea of how the thing looks. My neighbor on the north said it wouldn't do to have a fire in this neighborhood, as the firemen would certainly try to couple an engine suction hose to the thing. Neighbor on the south made a remark which came to me through the 'grape vine telegraph'—namely their maid to our maid to my wife: said it looked like 'Spark Plug.' Well, I did cover the end up with an old felt hat one night and threw a blanket over the rest of it.

"Standard six inch cast iron pipe fittings were used for the mount and it is as solid as the rock of ages. The only part on the job that I didn't make in my 'nut' shop back of the garage was the rack and pinion for focusing. I bought this for a dollar from a second-hand moving-picture supply house. The pipe fittings cost eight dollars and a half.

"The setting circles were made of brass

Mr. Graves' neat version of the Porter grinding-polishing machine

bands and fastened on with small pins like those used for fastening the nameplates on electric motors. I had to remove the threads on the short nipple and in the flange at its base in order to tilt the polar axis to 34°, our latitude. I drilled a couple of holes through flange and nipple and inserted bolts—one on either side—on which to hinge the nipple while making the adjustment. Then I locked it in place by means of a bolt acting as a set-screw (thread in the flange) as you will see by the photograph.

"The tube is made of heavy gage black iron electric welded. I squirted it with three coats of Duco primer and four coats of regular finishing Duco, rubbing down with fine emery paper and water after each coat. Two more coats of primer would have filled it perfectly but it doesn't look bad for an outdoor finish."

The "fire plug or Spark Plug" mounting

BETWEEN the fire-plug mounting that when suitably dressed up looked like the old hoss "Spark Plug" of the well-known comics, and the neighbors' pertinent or impertinent comments, Mr. Graves appears to have had his money's worth of fun. Just look at the pedestal he used—six-inch pipe fittings. Then contrast it with some of the one-inch fittings that some have used. That eight fifty was a good investment in rigidity and in appearance too. To emphasize the value of rigid mountings in even a light breeze, here is a note written by Dr. T. A. Jaggar, the volcanologist. He is referring to Mount Harkness, California, 8000 feet high. "The *entire mountain top*," he says, "is shaken by strong winds and the seismographs (mounted in a closed excavation in its top) show a very irregular record on windy days. Puffs and gusts of wind produce records of tremor with considerable amplitude." Because a telescope amplifies vibrations it is fully as sensitive to shakes as a seismograph. Even Mr. Graves' six-inch pipe fittings can be no stiffer than Mount Harkness. It is hard to overdo in the

Mr. Graves spoke of the time it takes to make a six-inch speculum. Ellison has set up a record of something like six hours from the beginning of the grinding to the end of figuring, but few of us are Ellisons. It is a fact that most new workers will spend about 30 evenings making a speculum. Well, what of it if it's all fun, as Mr. Graves says?

Don't forget the two gatherings of amateur telescope enthusiasts—at Springfield, Vermont, July 25 and Pittsburgh, August 8-9.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 131)

um. Fine silver stills and condensers, and silver-alloy taps and cocks are being generally employed to overcome the manifold troubles experienced in these particular industries.

For the melting and casting of the caustic alkalis, silver apparatus is employed, and stands up to its work well. An application of silver which has some slight connection with chemical engineering is in the Drumm storage battery. This is an alkaline electrical accumulator which, it is claimed, has much higher rates of charge and discharge than are found with any other known type and a much greater capacity per unit of weight.—*A. E. B.*

Soapless Cleansing Solution

A CLEANSING solution, recommended for many household uses, is described by *Silicate P's & Q's*. The formula is c ered by United States Patent 1753395. A mixture of 33 parts silicate of soda, 66 parts saturated borax water, and one part of ammonia is prepared by dissolving the borax, adding the ammonia, and stirring this into the silicate, thereby preventing gelation. One part of this solution in 10 parts of water is recommended for cleaning painted walls, woodwork, rugs, tapes- a mechanic's cleanser. The i ventor offers this as a convenient solution which will serve as a softener, will b irritant to the skin, and will not solidify or produce sediment.—*A. E. B.*

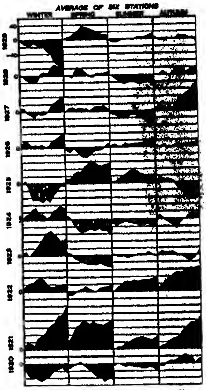
"Why, I Remember When . . ."

"THE earth's climate must be changing. We don't get the kind of winters we used to get. Why, I remember when I was a boy. . . ."

Probably every generation since the beginning has heard the same kind of statement from old-timers, but there really *is* ample scientific evidence that the past decade has been abnormally warm in the United States—which is not by any means to support the general claims of "when I was a boy." W. A. Mattice of the United States Weather Bureau at Washington has made a study of the past 10 years' weather in the United States and published a summary of the findings in the *Monthly Weather Review*, scientific journal of the Weather Bureau. From this we reproduce a set of graphs which tells much.

Mr. Mattice selected the records obtained at the six weather stations respectively at Washington, Cincinnati, Kansas City, Denver, Salt Lake City, and Sacramento. His graphs are composites of these six sets of weather records. They need perhaps some explanation. Looking at the graphs as a whole, the black areas represent warmer weather than normal and the gray areas cooler weather than normal. The zeros in the margin merely represent normal and have nothing to do with the actual temperatures. The black masses above zero and the gray masses below signify accumulated departures from normal, each horizontal line representing 20 degrees, Fahrenheit. We might just as well not notice such details which involve a technical method of representation regularly employed by meteorologists, for the black and gray areas tell the story. There is seen to be more black than gray—more warm than cold—in the last decade.

As Mr. Mattice puts it, "A general survey of the composite graph indicates that the past 10 years have been mild, on the whole, except 1920, and, with the exception of 1929 and 1925, the winters have also been rather mild. Springs also show a tendency



The weather has been abnormally warm but climates are not changing

toward mildness, while summers apparently are close to normal. Autumns are also mild, especially 1921, 1922, and 1927. It would seem, therefore, that the claim that the past 10 years have been rather mild is tiated by the evidence presented."

What, then, about "when I was a boy"?

The abnormalities Mr. Mattice exhibits have no connection with this familiar kind of argument. It is manifestly incorrect to attempt to judge the weather of the entire area of the United States from the observed weather in one small locality where the weather may have been exceptional, and it is equally unsafe to attempt an estimate of the whole world's weather from that of the United States. It would be equally unsafe to base a claim for permanently changed world climate on any 10 years or even on any 100 years, of weather records. As meteorologists know, the world's climate swings back and forth in a manner not yet fully understood. There is evidence for various cycles, short and long. These, with probable other effects, are superimposed on one another and the combined curve is not easy to figure out because it is so complicated and because our records cover so short a period of time. He who assumes that the world's weather has undergone a permanent change "since he was a boy" is like the man who, having had immediate and bitter experience

with stocks and depressions, assumes that a permanent change has set in. Neither can see the woods for the trees.

Finally our memories and general impressions often play tricks on even the most level-headed of us.

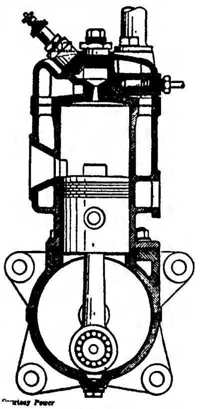
New German Semi-Diesel Engine

IN THE development of the high-speed oil engine, the semi-Diesel principle will not down, as many feel the lower pressures permit a reduction in weight and cost.

An interesting attempt has been made in this direction in Germany by two German engineers, who have invented a new type of motor to work either as Diesel or semi-Diesel, in which the lower compression and spark-plug ignition of the latter are the sole points of difference between the two systems.

The principle of operation of the motor is highly interesting. The inventors, Eugen Thomas and Robert Stuhr, of Düsseldorf, consider high-pressure pumps and small-bore nozzles objectionable in high-speed Diesels, as they are expensive to manufacture, while the nozzles are likely to give trouble through clogging up. The inventors have circumvented these difficulties by the adoption of a low-pressure fuel-feed system and a new form of ante-chamber.

The upper part of this ante-chamber is cylindrical in shape and has a flat top, and the bottom consists of a flat funnel with the



Courtesy Power

The new German semi-Diesel engine

apex pointing downward. The apex is connected by a vertical passage of conical section, and a horizontal passage in the wall of the ante-chamber communicates with the delivery side of the low-pressure fuel pump.

When the piston goes up on the compression stroke the fuel pump commences delivery at a very early stage, and has, therefore, to overcome but a slight pressure in the ante-chamber. Owing to the venturi-like form of the vertical passage a high speed is imparted to the air on its progress into the ante-chamber, the speed being higher the greater the piston speed. This high velocity causes a partial vacuum to set up around the top rim of the connecting passage, which draws in the fuel oil being delivered by the pump. A certain quantity of the fuel leaks over the rim and is caught by the air current, to atomize the fuel finely. The sudden increase of pressure caused by the explosion reverses the air current, closes the non-return valve in the fuel-feed opening and drives the burning gas and remaining fuel charge into the engine cylinder, where combustion is completed.

The speed of the converted semi-Diesel motor reaches 3000 revolutions per minute. Combustion is exceedingly good, for the exhaust gas shows no traces of odor even when starting or when changing gears. A single cylinder experimental engine built by the inventors ran at 4000 revolutions per minute, and they hope to obtain that speed in a new engine specially designed from the start to work on the principle evolved by them.

The obvious advantage of this type of motor is its extraordinary simplicity and the cheapness with which it can be produced, since expensive high-pressure pumps and finely calibrated and worked nozzles are dispensed with. The principle of working is just as applicable to four-stroke-cycle motors as to two-stroke-cycle.—Edwin P. A. Heinze, in *Power*.

In Defense of the Laundry

"THE laundries use acid on my clothes" is a common complaint.

Too common! The laundrymen have grown tired of hearing it and set their chemists to find proof that it is not so.

That was easy, for George H. Johnson, director of research for the Laundryowners National Association, says to the public:

"Next time you suspect that acid is used to get clothes clean, fool around with the innards of an automobile until your hands are greasy, and then try to get them clean with vinegar, or any other acid. Acids never did and never will remove dirt from clothes."—*A. E. B.*

Hafnium Has as Yet Few Uses

HAFNIUM, one of the most abundant of the newly discovered elements, has not yet found a definite place for itself in industry, according to the United States Bureau of Mines. A commercial future for hafnium is, however, already glimpsed in the radio industry, and its high melting point and electronic emissivity have already led to the taking out of patents for its use in radio tubes and incandescent electric lamp filaments and for the cathode surfaces of devices such as X-ray tubes and rectifiers.

Hafnium, which is element number 72, takes its name from Hafniae, the Latin name for Copenhagen, Denmark, where the research work of Coster and Hevesy, discoverers of the element, was performed, says Paul M. Tyler in a report recently published by the Bureau of Mines.

Due to the fact that the separation of hafnium compounds from zirconium compounds is laborious, and because of the lack of any extensive demand, hafnium compounds are expensive and not particularly easy to obtain in the market. In the

United States practically none of the metal seems to be available, but hafnia (the oxide) and hafnium chloride can be purchased in small quantities at a price of approximately 25 dollars a gram. Ores containing up to about 3 percent of hafnia can be bought for about 50 cents a pound and ore containing 5.5 percent may be had for $1.50 a pound.

The first hafnium salts produced in the United States were made by the late Prof. C. James of the University of New Hampshire in 1924 from crytolite obtained near Bedford, New York. However, although the zirconium salt which he prepared concomitantly appears to have been free from hafnium, the hafnium salt was unfortunately contaminated in process by zirconium through the interchange of fractions by careless workmen who had access to the laboratory. To date, therefore, pure hafnium salts have apparently not been prepared in the western hemisphere.—*A. E. B.*

ASQUITH AND KITCHENER

(*Continued from page* 117)

Secretary for War; Morley, Secretary for Ireland; and Lloyd George, President of the Board of Trade. By extending equal recognition to both branches of the Liberal Party and by the unexpected abilities he showed during his two years as Prime Minister, at his death in 1908 Campbell-Bannerman bequeathed to Asquith the Premiership, a good working majority in the Commons, and a united party.

While fortune again smiled on Asquith, Kitchener had become involved in a dispute with Lord Curzon, Viceroy of India, and had to be content with accomplishing considerably less than the reforms he had planned for the Indian Army. From India he went in 1910 to Australia where he laid the foundation of the present Australian Army. On his return to England, King Edward presented him with the baton of the Field Marshal and used his influence to have Kitchener made Viceroy of India in succession to Lord Minto. This was Kitchener's real ambition, but John Morley, who had become Secretary of State for India, would not have him, and though Asquith would have been glad to please his Sovereign and honor Kitchener, he would not overrule the responsible Cabinet Minister.

This incident is interesting as the first direct official contact of Asquith and Kitchener, one the Prime Minister of Great Britain, the other the Empire's greatest soldier except Lord Roberts then retired. King Edward died shortly afterwards and Kitchener believed that had Edward lived, he would have prevailed upon Morley to make Kitchener the Viceroy. If so, Kitchener would have been in India in 1914 and would probably have been retained there during the war.

After this failure, Kitchener was unemployed until 1911, when he was sent to Egypt, the scene of his first successes, as British Agent and Consul General. He was as successful as Satrap as he had been as Sirdar, and during his three years in Egypt he quieted the unrest in that unhappy country by removing some of the abuses that distressed the miserable Egyptian peasants. Kitchener was at his best in Egypt and in spite of the occasional bombs hurled at him and the Khedive, he led a quieter life in Egypt than Asquith did in England, for this was the period of the militant suffragettes, the struggle with the House of Lords, and the Carson volunteers in Ulster.

Simultaneously, foreign affairs pressed on Asquith for decision. Grey at the Foreign Office confronted one European crisis after another until the Agadir incident in 1911 forced the most optimistic and pacifistic members of the Cabinet to realize that Europe was on the brink of war. Asquith was already aware that Great Britain could no longer hold aloof from a major European war, and as Prime Minister increased the usefulness of the Committee of Imperial Defense. He opposed Lord Robert's program for compulsory service and gave his powerful support to Lord Haldane's alternative scheme that provided an Expeditionary Force of six divisions of regulars ready for instant service, a Territorial Force for home defense, and the Special Reserve to provide replacements for the Expeditionary Force. The main disadvantage of the Territorial organization was that its members could not be ordered abroad without their consent.

IN addition to this land force, the British Navy, the largest in the world, although no longer up to the "two-power" standard and increasingly pressed by the German High Seas Fleet, was potentially on the side of Britain's allies. The relative weakening of the British Navy was due to the need for appropriations for old-age insurance and other modern social legislation strongly urged by Lloyd George, Morley, and John Burns. The struggle for naval funds was led by McKenna, First Lord of the Admiralty, while it was opposed in the Cabinet by Lloyd George and Winston Churchill until the Agadir incident.

At a secret meeting of the Committee of Imperial Defense in 1911 subsequent to Agadir, Asquith made the astonishing discovery that the War Office and the Admiralty were poles apart on their war plans. The Army contemplated landing the whole Expeditionary Force in France; the Navy proposed landing this same force in detachments along the Baltic shores of Prussia. Admiral Wilson supported the Navy view, but General Nicholson pointed out the unwisdom of this plan in view of the German railway system and superior army. On conclusion of a very stormy meeting, Haldane, who had studied the German organization for war and had labored for six years preparing the Expeditionary Force for dispatch to France, told Asquith he would no longer accept responsibility for the Army unless a drastic change were made at the Admiralty in order to bring the two services into accord.

Asquith decided in favor of Haldane and the Army plan, and sent Winston Churchill and Prince Louis of Battenberg to relieve McKenna and Sir Arthur Wilson of their posts in the Admiralty with instructions to organize a proper Naval General Staff. Lloyd George was also converted by the Agadir incident, made his defiant Mansion House speech, and definitely aligned himself with the party in the Cabinet who believed war with Germany was probable if not inevitable. With Lloyd George came

Churchill and this gave Asquith for the first time a working majority in the Cabinet willing to support reasonable preparations for war. Lord Loreburn, Lord Morley, and John Burns were still pacifistic, but Asquith could now proceed with more firmness in foreign affairs.

Time pressed, for early in 1912 Churchill found it necessary to recall a squadron of battleships from the Mediterranean to reinforce the British Fleet in the North Sea; this practically abandoned the Mediterranean and the Army chiefs promptly asked the Navy if, in the event of war, the communications with the Army garrisons in Malta and Egypt could be maintained. The Navy answered "No." Asquith again confronted a major problem; the Foreign Office advised him that he had three alternatives: (1) To get the French Fleet to guarantee British communications in the Mediterranean; (2) To make an alliance with Germany; (3) To increase the Fleet so that the North Sea and Mediterranean could both be held. The Government thought it could not afford the expenditures necessary to raise the strength of the fleet; an alliance with Germany would acknowledge her as the dominant European power, a result repugnant to the entire Cabinet; so the Cabinet decided to turn over its interests in the Mediterranean to France. In return, this obligated Great Britain to protect French interests in the North Sea and the Atlantic, and linked Great Britain by ties of honor as well as of interest.

Germany learned of these conversations, realized that England was definitely committed to France, and ceased her efforts to detach England from the Entente. This change in attitude actually improved the relations between England and Germany; for Grey industriously sought some formula to satisfy German aspirations and in spite of the strains caused by the Balkan War in 1913, Britain and Germany individually were more friendly in the spring of 1914 than in the previous decade. Asquith was fully occupied with domestic affairs, had complete confidence in Grey's intentions and abilities, and gave him a free hand at the Foreign Office. In the spring of 1914, Grey had practically concluded an agreement with Germany that settled all questions at issue directly between Germany and Great Britain, including the vexatious question of the Berlin-Bagdad Railway. But Germany was linked to Austria, and Great Britain to France and Russia; a residue of bitterness and suspicion remained in both countries, and the naval rivalry continued.

IN the spring and summer of 1914, Asquith's government was fully occupied with the Ulster movement under Carson which took on serious proportions because many Conservative leaders and Army officers were openly or secretly for Ulster. At the height of the crisis, Asquith accepted the resignation of the Secretary for War and took personal charge of the War Office. He had waited, perhaps over long, for the situation to develop, but then he acted firmly and took personal direction of the War Department, which would be the critical post.

At a cabinet meeting on July 24, called primarily to consider Ulster, the interest of the members first turned toward Serbia and Austria. For the next 10 days Asquith presided while the Cabinet grappled with the question of war or peace. He was kept informed of Grey's efforts to avoid war, and he permitted Churchill to keep the British Fleet, which chanced to be carrying out a test mobilization, on a war basis. He was anxious lest the Cabinet split along the line of cleavage that had rent the Liberal Party during the Boer War; he feared that a formidable number of colleagues would resign, that public opinion would divide on the question and Britain enter a major war with a divided people.

EVIDENCE now available indicates that Asquith was unnecessarily apprehensive about Britain's willingness to accept Germany's challenge; hostile critics say he was forced into the war by public opinion, but there was some reason for his hesitation. The murder of the Archduke had at first excited sympathy for Austria among average Englishmen who could see no reason for their getting involved in a Balkan war. At the prospect of a European war, as Asquith had feared, the Cabinet split at first into almost equal groups, the interventionists led by Grey, the non-interventionists by Lloyd George. Possibly an appeal by Asquith to public opinion would have forced the hands of his reluctant colleagues. Even so, a split Cabinet on the eve of war was not to be lightly accepted, so the French Ambassador was told as late as August 1, that "France must make her own decision at this moment, without reckoning on an assistance which we (the Government) are not now in a position to promise."

By August 2, the situation was crystallizing; Bonar Law, leader of the Conservatives, wrote Asquith to "offer an unhesitating support to the Government in any measures" they took to assist France. On the same afternoon, Asquith with the Cabinet consent was able to inform Germany and France that German ships would not be allowed to pass through the North Sea or English Channel to attack the coast or shipping of France. Thus England honored her written obligation to France, which called only for naval assistance. The situation developed rapidly thereafter and the German invasion of Belgium so stirred British public opinion that on August 14, Asquith, marching with a united people and practically a unanimous cabinet, brought the full support of the British Empire to the Entente, and for over four years the British people redeemed in generous measure all British promises, written or implied.

Thus in his own groping, halting, almost faltering way, Asquith brought his country into the war, and with it a united party. Fortunately for England, Churchill, who delighted in responsibility, had already mobilized the British Fleet and deployed it between England and the enemy, so the Cabinet could debate the question of war in safety. But England's almost allies, France and Russia, writhed in agony while the decision hung in the balance; abroad doubts arose about England's good faith and precious time was wasted. In judging Asquith's conduct, American readers must remember that the Prime Minister does not have the same authority over his cabinet that our President has; he is only the "first among equals" and must persuade rather than direct.

(To be concluded)

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Langmuir Patent Invalid

THE patent covering high vacuum radio tubes, acknowledged to be the type universally used in radio receiving sets, was declared invalid on May 25 by the Supreme Court of the United States, reports *The United States Daily*. The decision of the ....t Court of Appeals for the Third Circuit, which the Supreme Court reversed, was given on page 142, of the February, 1931 issue of the SCIENTIFIC AMERICAN.

The validity of the Langmuir patent, No. 1558436, owned by the General Electric Company, had been contested by the De Forest Radio Company, charged with infringement of the patent.

The court concluded in an opinion by Mr. Justice Stone that the production of the high vacuum tube, in view of the prior art which included contributions of Dr. Lee de Forest, resulted only from skill of those practiced in the art and did not constitute invention, and, therefore, was not patentable.

Explaining the claims for the high vacuum tube, the opinion states that they cover methods "of creating the high vacuum by freeing the tube of occluded gas by heating tubes and electrodes and by electronic bombardment, at the same time evacuating the tube of air or gas by approved methods."

"It suffices to say," the court concluded, "that an examination of the prior art discloses that long before the earliest date claimed for Langmuir, the necessity of removing occluded gas from tubes or other electrical discharge devices in order to produce a high vacuum, and the methods of doing it were known, as was the procedure for construction of the high vacuum tube by expelling occluded gas while evacuating the tube."

While high vacuum was an effective means of producing in the old tubes of the art the stable current which could not be produced "in the presence of ionization," according to the opinion, there was no suggestion of the discovery "of a scientific truth that essentially different principles control the discharge in low vacuum tubes from those which operate in high."

Granting a difference between the low vacuum and high vacuum tubes, the court declares: "It is no more than the scientific explanation of what Lilifield and others knew, before Langmuir, of the effect of the high vacuum on the discharge, and the methods and devices for procuring the vacuum. It is method and device which may be patented, and not the scientific explanation of their operation."

Chemical Patents

APPLICATIONS for patents relating to chemistry comprise one eighth of the issuance activities of the United States Patent Office, the Commissioner of Patents, Thomas E. Robertson, stated recently.

Of the 63 technical divisions in the Patent Office devoted to consideration of applications for patents, eight deal almost exclusively with subjects relating to chemistry.

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Additional information made available by Mr. Robertson follows:

Latest figures show a total of 17,058 applications awaiting action by the chemical divisions. This mass of work is distributed in jurisdictions of the various "chemical divisions" as follows:

Heating, metal founding, metallurgy, and metal treatment, 991; carbon chemistry, 2185; glass, plastic block and earthenware apparatus, and plastics, 2623; distillation, heating and illuminating gas, and mineral oils, 2590; plastic liquid coating compositions, and coating, 2500; electrochemistry, laminated fabrics, paper making, and substance preparation, 1977; chemistry, alcohol, fertilizers, cement and lime, hides, skins and leather, and fuel, 1719; bleaching and dying, explosive, pyrotechnic and match compositions, oils, fats, and glue, preserving, sugar, starch, and carbohydrates, 2473.

AAA Trademark Upheld

THE Automobile Owners Association of America, of Baltimore, Maryland, is not entitled to register, as a trademark for maps, especially mileage road maps, a mark consisting of an elliptically shaped device containing the applicant's name and having within the outer line a smaller concentrically positioned elliptical figure within which is the representation of a shield covering the body of a conventional representation of an eagle, the head, wings, and feet of which show beyond the edges of the shield, according to a decision by First Assistant Commissioner Kinnan.

The ground of the decision is that this mark is confusingly similar to a previously registered mark (registration No. 155,190) of The American Automobile Association, Inc., of Washington, D. C., consisting of a rectangular panel upon which appear the opposer's name with an elliptical figure in the center containing the letters "AAA" and above which is a representation of the wings of a bird, presumably an eagle, and used as a trademark for the same goods.

In his decision, after stating that it was at least doubtful that applicant's mark was confusingly similar to other marks of the opposer consisting respectively of two intertwined automobile wheels with the letters "AAA" placed thereon, and an elliptical figure within which are the letters "AAA," and stating that there was reasonable probability of confusion between applicant's mark and that of registration No. 155,190, the First Assistant Commissioner said:

"Elliptic and rectangular panels for signs, trademarks, and so forth are so very common that the difference in contour here shown would not be readily noted or remembered, especially where the marks do not appear side by side for comparison. The applicant has taken substantially the entire group of words appearing upon the opposer's panel, merely transposing their relative positions but conveying the same impression and information."

Film Case Review Sought

A PETITION for review of a case involving a patent claimed "as the patent which made possible, and upon which has been built, the talking motion picture art" has just been filed with the Supreme Court of the United States, reports *The United States Daily*.

General Talking Pictures Corporation and De Forest Phono-films seek the review by the court of a decision of the Circuit Court of Appeals for the Third Circuit holding the Reis patent, No. 1607480, covering a method or process used in reproducing talking pictures, not infringed by apparatus used by The Stanley Company of America. (See page 426, June, 1931, SCIENTIFIC AMERICAN.)

The patent in suit, according to the petition, relates "to the method of reproducing sound waves photographically recorded on motion picture film." The patent concerns only the reproduction of talking pictures.

In setting out the contribution of the patentee to the art, the petition states:

"Reis discovered a method of recording and reproducing sound waves which made it possible to use the relatively slow speed of film travel which was standard in the motion picture industry, without overlapping and distortion of the sound wave images. That method, in so far as it relates to reproduction of photographically recorded sound waves, constitutes the invention shown, described and claimed in the patent in suit.

"It was Reis' discovery that if the light-sensitive surface or film is moved in such relation to an aperture that the area of exposure does not exceed the area of the aperture, it was possible to produce and reproduce a perfect sound record, and also possible to adapt it to standard motion picture speed without incurring overlapping of the sound wave images.

"That the Reis method solved the problem which had retarded the development of the art for many years is evidenced by the fact that talking motion pictures are now a universally accepted fact, and that all projectors employed therewith, by one means or another, employ the Reis method —moving the film sound record in such relation to the aperture that the area of exposure of the sound record is limited to the area of the aperture, with the film moving at a speed of travel standard to the motion picture industry."

The petitioners complain of the lower court's opinion on the ground that it erroneously held "a method or process patent not infringed, because of differences in mechanical structure between the alleged infringing device and that illustrated in the patents as one means of use."

Chemical Coating Makes Glass Opalescent

A COATING for application to glass, which will give an opalescent effect, is disclosed in United States Patent 1752792, says a recent issue of *Silicate P's & Q's*, house organ of the Philadelphia Quartz Company. One hundred grams of kaolin, 50 grams of zinc phosphate, 15 grams of caustic soda, and 1000 cubic centimeters of sodium silicate of specific gravity 1.025 are claimed as a mixture which is very efficient for use in electric lamp bulbs or similar glass objects.

The original method of using an opal glass was expensive and unsatisfactory because under the high heat there were certain decompositions which shortened the bulb life. Etching of the glass by hydrofluoric acid gave diffusion but not opalescence, and decreased the light efficiency. The present mixture absorbs less light, does not affect the bulb strength, flows easily so it is a simple matter to coat the bulb interior, and aids in sealing the glass. The silicate, when dehydrated, acts also as a pigment. If a colored coating is desired, the color may be added and the amount of filler proportionately decreased to maintain the proper consistency for application.

The coating is applied by spraying or flushing into the bulb, the excess is removed by draining or a vacuum and this is followed by subjecting to a relatively high heat to produce instantaneous setting. Baking for three or four minutes at 300° Centigrade to dehydrate the binder, to solidify the coating completely, and to remove occluded gases, finishes the job. The coating is entirely permanent although it can be removed by abrading and flushing with water if that should be necessary.—*A. E. B.*

Price Fixing Banned

THE Federal Trade Commission has ordered Coty, Inc., importer and dealer in cosmetics, New York, to discontinue methods of resale price maintenance.

The company is to stop carrying into effect by agreements, contracts, or co-operation, a system of suggested resale prices for the articles it sells by such means as (1) agreements with wholesale or retail dealers that the company's products will be resold by such dealers at prices specified by the company; (2) procuring assurances from either wholesale or retail dealers that the prices fixed by the company for resale of its products will be observed by such dealers; and (3) seeking co-operation of dealers in maintenance of resale prices suggested by the company for its products.

The Commission found that the company made it generally known to the trade by letters, telegrams, and interviews, that it expects dealers handling its products to maintain its suggested prices. When information would be received by the company indicating that vendors of Coty articles in a particular city were not maintaining the suggested prices, the company would send its agents to such a city to interview these dealers, and to point out to them the company's price maintenance policy and insist that they maintain suggested prices. Such agents would obtain from the wholesale and retail dealers agreements to maintain such prices.

The company has refused to sell its products to wholesale and retail dealers who have not maintained suggested prices and who will not agree to maintain such prices in the future.

The company has furnished names of wholesale or retail dealers whom it has refused to supply with products, directly to those dealers who maintain the respondent's suggested prices or who are selling in the territory where are situated the dealers who had been cut off.

Since 1928 the company has not made a practice of notifying its vendees when such price cutting dealers have been cut off for failure to observe the suggested resale prices.

"Tiol" versus "Tydol"

A RECENT decision by the Patent Office holds that The Pure Oil Company, of Chicago, Illinois is not entitled to register, as a trademark for motor fuel oil, lubricants and greases, and so forth, the term "Tiol," in view of the prior use and registration by the Tide Water Oil Company, of Bayonne, New Jersey, of the term "Tydol" as a trademark for gasoline and "Tycol" as a trademark for lubricants and greases.

In his decision, after referring to applicant's argument that the term "Tiol" is but a mere variant of the applicant's mark "Tiolene" used long prior to any date of use claimed by the applicant and already registered, and noting applicant's argument that the opposer's marks are confusingly similar to its mark "Tiolene," the First Assistant Commissioner said that, while it was stipulated that no actual confusion had taken place,

". . . yet the similarity of the applicant's mark to those of the opposer is regarded as such that confusion in trade would be almost inevitable if the marks of both parties appear in the same market upon their respective goods. The opposer's mark 'Tycol' is good upon identically the same class of goods while its mark 'Tydol' is used upon gasoline. These products, gasoline and lubricating oils, are usually sold at the same supply stations and to the same class of customers and are used in connection with motor vehicles."

Spurious Mercurochrome Outlawed

"MERCUROCHROME," the trade name for a well known antiseptic produced by a Baltimore pharmaceutical laboratory, is not to be used by another concern to describe a preparation which is not Mercurochrome, the Federal Trade Commission ruled in an order to Maurice Talmadge, Chicago, trading as DeBestt Chemical Company.

The Commission specifically ordered Talmadge to cease representing that his so-called antiseptics are "Mercurochrome" unless compounded from the chemical formula for "Mercurochrome," which is technically known as "disodium salt of dibrom-oxymercuri-fluorescein."

Talmadge designated his preparation as "Mercnrochrome H. W. D. Two Percent Solution," representing it as a general antiseptic for use in place of iodine. The Commission directed him to cease representing the solution by use of that expression unless the preparation advertised is a two percent solution of the disodium salt compound of which Mercurochrome is composed, and which salt has been produced in the pharmaceutical laboratories of Hynson, Westcott & Dunning, Baltimore.

In its findings the Commission declares that Mercurochrome has been on the market and sold in the form of a two percent solution possessing a deep cherry color, for use as a general antiseptic, and has been recognized and identified both by the medical profession and the public by its trade name, "Mercurochrome," and its striking color in solution. The color is not artificially produced. The process of production is patented by Hynson, Westcott & Dunning, and is sold under that trade name with the accompanying initials "H. W. D."

The Commission found that the Chicago concern's preparation was a spurious product containing little if any Mercurochrome.

"Radiofilm" Refused Registration

IT was recently held by First Assistant Commissioner Kinnan that the R. C. A. Photophone, Inc., of New York, New York, is not entitled to register, under the Act of 1905, the notation "Radiofilm" as a trademark for combined sound and motion picture films, since the word is merely descriptive of the goods.

In his decision, after referring to certain publications with reference to the use of picture films in connection with radio transmission prior to the time applicant claims to have adopted his trademark, the Assistant Commissioner said:

"From the foregoing it is deemed clear enough that those ordinarily skilled in this art would understand the applicant's alleged trademark to mean no more than that the film was to be used in connection with radio apparatus. Indeed it would seem quite difficult to devise a notation more clearly descriptive, and descriptive only, of the goods upon which applicant uses the notation.

"As noted by the examiner it is immaterial whether the applicant's film is to be used in radio apparatus. The notation is equivalent to the statement the film is to be so used and if this is not the fact, the notation is misleading and misdescriptive."

Battery Solution Misrepresented

A CORPORATION manufacturing a battery solution signed a stipulation with the Federal Trade Commission, agreeing to cease the use in advertising matter of statements implying that the product will instantly charge, or cause an immediate electrical energy to enter plates, or that the product, when so used, will not freeze, when such is not the fact.

The company also agreed to stop use of all statements which are false, misleading, or deceptive, or that are in excess of what may be accomplished by the use of its product as a battery solution.

Books SELECTED BY THE EDITORS

DYKE'S AUTOMOBILE AND GAS ENGINE ENCYCLOPEDIA

By A. L. Dyke

ANY reference of this kind covering an ever changing field of production such as the engine industry must be up-to-the-minute in order to be really useful; at the same time it must give enough of the history of development of the individual units to lend the necessary background upon which the latest refinements are imposed. This 16th edition does just that. Personally we find it indispensable for its amazing breadth of information, running as it does into all the collateral lines of accessories covering practically every branch of automotive mechanics. If you do not know this work you should get it. If you have an old edition you should acquire this 16th—you would scarcely believe that so much new material could be produced in so few years.—Cloth \$6.30; flexible \$7.80, postpaid.

OPTIKS: OR A TREATISE ON THE REFLECTIONS, REFRACTIONS, INFLECTIONS AND COLOURS OF LIGHT

By Sir Isaac Newton

AN exact reprinting of the corrected fourth edition of *Optiks*, published in London, England, in 1730, three years after Newton's death. It holds a twofold interest for the physicist; first, because it "can afford us the enjoyment of a look at the personal activity of this unique man"; second, because enough of Newton's findings, formerly valued chiefly for the depth of theoretical and experimental skill which they evidence, are finding analogies in present-day research to give this book a living scientific interest. The foreword is by Professor Albert Einstein and an introduction by Prof. E. T. Whittacker. In two books divided into several parts. A good second-hand copy of the original first edition sells for at least 20 dollars and rarely appears.—\$2.65 postpaid.

SEEING

By M. Luckiesh, Director, and Frank Moss, Lighting Research Lab., G. E. Co.

A SPECIAL corner of lighting on which little data has been available is now strongly illuminated by this new book. It is mainly for the illuminating engineer and lighting specialist, but almost equally for the psychologist, physiologist, ophthalmologist, optician and optometrist, and all others interested in the science of good seeing. In every industrial plant there is or should be someone who understands more than superficially the important connection between lighting, vision, and production. This book will measurably deepen such an understanding. Some of the contents are: fatigue, contrast, speed of seeing, effect of surroundings, glare, general lighting, cost and value, and so on. A theoretical, basic book that is practical too.—\$5.20 postpaid.—*A. G. I.*

THE BOOK OF THE MICROSCOPE

By Gerald Beavis

NEARLY everyone has examined a dead fly's wing or a dull, featureless hair under the microscope but relatively few realize, even remotely, the endless extent, the wide variety, and the lively fascination of the invisible world that lies so close to us wherever we go. This new and popular book of 246 pages (illustrated) provides a pleasant approach to the world of microscopic marvels. Without any of the earmarks of a treatise or textbook it tells how to observe and what to observe in the animal, vegetable, and mineral kingdoms. This vast world contains an endless variety of subjects. Microscopy, once tasted, usually becomes a lifetime hobby and incidentally it is an inexpensive one. Thanks to mass production it is now possible to buy microscopes magnifying two or three hundred diameters for only ten or twenty dollars and these are of excellent quality. A million marvels await the amateur microscope fiend. It is a good way to keep sane and out of jail. —\$2.65 postpaid.—*A. G. I.*

SCIENCE AND FIRST PRINCIPLES

By F. S. C. Northrop, Assoc. Prof. Philos., Yale

HEISENBERG'S principle of uncertainty and other new concepts having recently upset the scientific applecart, everybody is now trying to right it up again, and this book is a philosopher's attempt to do so. The reader will be the final judge whether this aid from without the ranks of science is efficacious or only results—as we think—in confusion worse confounded. The book would not be light summer reading for *Homo neanderthalensis*, but a sapient *Homo sapiens* conld manage it easily if he had previously kept track of the more significant trends in profound scientific thought.—\$3.20 postpaid.—*A. G. I.*

GEOPHYSICAL METHODS OF PROSPECTING

By C. A. Heiland, Prof. Geophysics, Colo. School of Mines

A VERY practical 163-page treatise on all the methods of geophysical prospecting, containing data on costs, makers of the various apparatus, names of oil and mining companies which use it and to what extent. The author is one of the leading authorities on this form of scientific and practical research. To be obtained directly from the Colorado School of Mines, Golden, Colo.—\$1.15 postpaid.

FLYING DUTCHMAN

By Anthony H. G. Fokker and Bruce Gould

BUILDING a plane before he ever saw one in the air, the "Flying Dutchman" taught himself to fly. He was the first to loop-the-loop and eventually designed the Fokker planes that made Immelman and Richthofen famous. Coming to this country he today, at the age of 40, stands at the head of an international organization distributing the products of his genius throughout the world. Fearless and self confident, he says what he thinks, as he has acted throughout his life. The comments on Byrd, Balchen, and other fliers are spicy and entirely his own line of belief. Much of the history of aviation is enclosed in this story. One of the most interesting books of its kind that has appeared.—\$3.20 postpaid.

SAILING THE SKIES

By Malcolm Ross

AN introduction to the sport of gliding designed to satisfy the curiosity of those unable to take actual instruction and to furnish the gliding student with the information he needs before he first sets foot to the rudder bar. It tells why planes fly, takes tips

from the birds, describes the best types of gliders and sailplanes and their launching methods, discusses air currents and gliding terrain, weather and clouds and gives accounts of great soaring flights and how they were made.—$2.65 postpaid.

RECORDING SOUND FOR MOTION PICTURES
Edited by Lester Cowan

A SERIES of lectures prepared for the Academy School of Sound Fundamentals, reinforced by additional chapters and a complete glossary of terms, is here presented in book form. Numerous photographs and drawings supplement the explanatory text. Some fundamentals are given, but in general the purpose of the book is to acquaint those familiar with "silent" motion picture work with the sound recording processes. Although parts of the work are involved and technical, the greater portion should be understandable and informative to the average person who desires to be "up" on sound picture matters.—$5.20 postpaid. *A. P. P.*

PHOTOGRAPHIC AMUSEMENTS
By Frank R. Fraprie and Walter E. Woodbury

ALTHOUGH this book first made its appearance in 1896, it has gone through numerous editions since that time, each one being brought up to date, yet retaining the most interesting features of the original. The book in its present form is presented essentially for the photographer who does everything from making his exposures to printing his own positives; however, even the veriest tyro who snaps the picture and turns the film over to an "amateur finisher" will find much to intrigue him. Subjects covered range from simple double exposures, "ghost" pictures, and double printing to solar photography, photo-caricatures, trick effects in "home movies," and the so-called modernistic phases of both still and motion photography. The part dealing with camera angles interested us most; it explains many points that, when viewing finished photos and movies, have often puzzled. If you own a camera, you will want to read this book and acquire knowledge that will help you to depart from the monotony of ordinary photography. As a source from which to devise your own trick effects, you will find that the suggestions given will open fields hitherto explored only by professionals and rabid "camera fiends."—$3.20 postpaid.—*A. P. P.*

BUTTERFLY AND MOTH BOOK
By E. Robertson-Miller

THE result of personal studies and observations of the more familiar species during many years, given in a readable way, amply illustrated. Life-stories of the moths and butterflies all of us are likely to encounter and about which most of us know nothing. 281 pages. 5" x 7½".—$2.65 postpaid.

MAGAZINE MAKING
By John Bakeless

ANYTHING which pertains to his work is naturally of interest to an editor; we therefore approached the reading of this book with anticipation. Nor were we disappointed, as we read and found that what is essentially a text book is as interesting as a novel. The author has taken a subject which, seemingly simple, presents ramifications that are not apparent on the surface, and from his years of experience in the business has built up a running story that will hold the attention not only of those actively connected with editorial work, but of anyone who reads magazines. In scope, the book covers every branch of magazine publishing from the economic basis of the business, through the organization of the staff—the editorial, circulation, and advertising departments—to the relationships between authors and editors, and magazine publicity. A comprehensive bibliography furnishes a vast array of titles for further reading on the subject.—$3.20 postpaid.—*A. P. P.*

NOGUCHI
By Gustav Eckstein

EXTREMELY well done both in format and outline, this very enthusiastic biography delineates the fine shades of contrast in this, one of the most important and picturesque lives that the broad field of science has produced. Master of the technique of pure culture, his success in any one line of his many researches would have made him internationally famous. All his endeavors were impelled by an almost frenzied desire to alleviate human suffering, and he never hesitated in his work on virulent bacilli. Truly a martyr to science in every sense of the word.—$5.20 postpaid.

MEMORIES OF SIXTY YEARS
By Henry Sanderson Furniss

SEMI-BLIND from youth because of lack of prophylactic treatment at birth, with a courage and will that nothing could overpower, Lord Sanderson eventually became a strong force in politics, known throughout the land. However, it will probably be his work with the blind for which his memory will eventually be cherished, for in the endeavor along this line he was a pioneer, lending his own experience, as well as his constructive ability, to its firm establishment. One reads this autobiography with a feeling of tremendous admiration and stimulation—told as it is in simple, matter-of-fact, though easy flowing style.—$3.20 postpaid.

THE HISTORY AND IDEALS OF AMERICAN ART
By Eugen Neuhaus

IT IS rare that we have the combination, as in this case, of a historian and a critic who can make an esthetic analysis of the glorious material which our easel and mural painters have presented. The author is Professor of Art in the University of California, thus being in a position to record the beginnings and the development of art in the West and on the Pacific Coast; a valuable point usually forgotten. The subject is developed along two lines: first the tracing of the various influences derived from Europe and elsewhere, which has helped to shape American art; and second the association of artists by subject affinity, which greatly clarifies a comprehension of the various schools. Many artists cannot be classified as their work is what might be called "tangential," but these men and women are not neglected in this interesting text. There are 142 softly executed engravings of paintings and also reproductions of a few etchings and lithographs; the process employed permits this lavish illustrative material. The concise readable style of this able critic makes a work of enjoyment entirely apart from the usual art criticism.—$6.85 postpaid. —*A. A. H.*

THE ROAD BACK
By Erich Maria Remarque

UNDOUBTEDLY this is a more finished product than "All Quiet on the Western Front," but one cannot but wonder if the physical and mental condition of the men of the small town this story describes is typical of any very great number throughout entire Germany. It takes the characters a seemingly unnecessary length of time to readjust themselves and the question readily arises as to whether they would not have sooner arrived at a sane viewpoint of life if they had gone to work and not lazed around allowing their minds to be filled with self pity. However, this is a book that must be read if for no other reason than that it does suggest the extreme penalty that war exacts in certain cases.—$2.50 postpaid.

SCIENTIFIC AMERICAN
ADVERTISERS

AUGUST · 1931

GEORGE A. TOWNSEND, Mid-Western Advertising Manager
6 North Michigan Ave., Chicago, Ill.
BLANCHARD-NICHOLS-COLEMAN
Western Advertising Representative: Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

Vol. 145, No. 2. Price 35 cents a copy. $4.00 a year. Foreign $5.00. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year, postage prepaid.

WHO CAN TELL!

A. B. Wilson's Invention

1845 - 1931

DURING 1849 the SCIENTIFIC AMERICAN illustrated and described four different sewing machines that had just been produced. One of these was the invention of A. B. Wilson, later to be known as the Wheeler and Wilson.

James E. A. Gibbs saw these descriptions and they inspired him to produce the Wilcox and Gibbs sewing machine with its ingenious revolving hook to make a loop stitch.

So too Isaac M. Singer patented his machine in 1851 by substituting circular feed, thread control, gear wheels, shafting and foot drive.

Thus has SCIENTIFIC AMERICAN taken a most important part in the development of this essential household utility.

Today, as faithfully as in the past, this 86 year old magazine records scientific development.

Who can tell what future achievement may evolve from today's authenticated descriptions of industrial activities

O. S. Treadwell.

Vice-President • Advertising Director

Only when Gasoline PASSES *this* PHYSICAL EXAMINATION

can it become Ethyl Gasoline

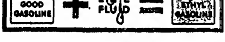
EVERY batch of Ethyl Gasoline must go through a literal third degree before it reaches the tank of your car.

First, a sample of the base gasoline goes before a board of "gasoline doctors" in one of the six Ethyl laboratories.

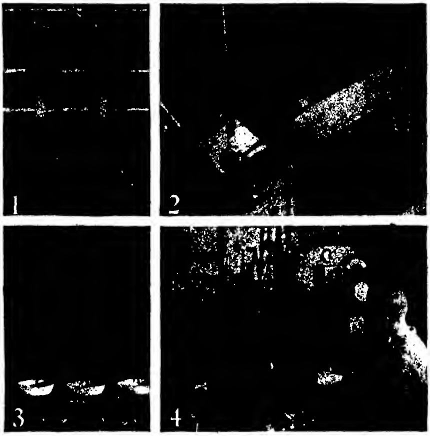
They delve into its ancestry for gum and sulphur, hereditary diseases of gasoline. They sound its nerves to determine how jumpy it is, how quickly it will knock. They test it for volatility—the quickness with which it changes from a liquid to a vapor ready to deliver power.

Only when gasoline passes all tests can it be mixed with Ethyl fluid. After it has been mixed at the refinery, it comes back to an Ethyl laboratory to go through the same tests for a second degree. It comes back for the third degree in the samples that Ethyl inspectors buy from roadside pumps.

Every time you "fill 'er up with Ethyl," you get gasoline that has passed these strict tests. That's why you always get *good* gasoline—*plus controlled* combustion: the fine performance, the quicker getaway, the added power on hills that only Ethyl can give. Ethyl Gasoline Corporation, New York City.



The active ingredient used in Ethyl fluid is lead.



1. SULPHUR is as dangerous in gasoline as tonsils often are to people. So Ethyl chemists burn gasoline samples and catch the products of combustion by bubbling them through soda to make sure of low sulphur content.

2. VOLATILITY is the quality that makes you jump out of bed in the morning feeling like a six-year-old. And gasoline must have this quality before it can become Ethyl Gasoline.

3. GUM makes for intestinal sluggishness in any car. So gasoline that becomes Ethyl must have a low gum content. Shown pictured here are the evaporating dishes used to show how much gum each sample has.

4. KNOCKING is the influenza of gasoline. It is cough, sneeze and weakened power rolled into one. This test tells how much Ethyl fluid is needed to make the patient sound and healthy again—free from any knock.

ETHYL GASOLINE

ON THE TOUGH JOBS

OF COURSE, THEY'RE SKF

SKF-equipped road building machine in action and above (left), driving wheel on stone crusher turning on SKF Bearings.

"*IN A BEARING THERE'S NOTHING BUT* PERFORMANCE *THAT COUNTS*"

That's the job...where the grind is steadiest and the going hardest, where dependability is essential and performance is the thing that counts...*that's* the job for SKF.

It's no mere chance that you find SKF Anti-Friction Bearings in the railway journals of most of the railroads of the world...in most of the great clanging mechanical monsters that build our roadways . . . in practically all of the giant dredges that burrow into river bottoms. Not chance at all. Ordinary bearings would fall down.

The answer is that SKF builds a bearing *up* to a job and never *down* to a price. And whether it's a dime-sized SKF Bearing, functioning in some delicate scientific instrument at terrific speed, or a big brute SKF, taking the punishment of some giant stone crushing machine and *liking* it, depend upon it . . . it was built for the job. SKF puts the *right* bearing in the right place . . . and in a bearing there's nothing but performance that counts.

SKF INDUSTRIES, INC., 40 EAST 34th STREET, NEW YORK, N. Y.

SKF

BALL AND ROLLER BEARINGS

2741

SCIENTIFIC AMERICAN, September 1931, Vol. 145, No. 3 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Copyrighted 1931 by Scientific American Publishing Company, Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00.

SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · SEPTEMBER · 1931

SCIENTIFIC AMERICAN DIGEST

ACROSS THE EDITOR'S DESK

ASK the average man to tell you something of the materials which are used in varnishes and nine times out of ten he will start off with linseed oil turpentine and some kind of natural resin Ten years ago he would have been correct but since then the paint and varnish industry has undergone a series of rapid changes that lend an entirely new aspect to the situation With the development of cellulose lacquers with which every one is more or less familiar paints and varnishes were dealt a severe blow Lacquers are convenient to use and have the decided advantage of quick drying Old style varnishes and paints must be carefully applied if good results are desired and they are slow drying But the synthetic chemist has entered the field and shown the struggling industry how to produce paints and varnishes that can compete with other finishes by presenting the same desirable qualities including quick drying D H Killeffer tells the whole story of this industrial development in an article soon to be published

●

Some time ago the SCIENTIFIC AMERICAN presented what was probably the first authoritative detailed story of the development of airways between North and South America and on the latter continent The author of this article Miss Anne Peck by the way has since toured South America doing practically all of her traveling by plane Developments since the publication of that article have been rapid and we have had prepared another survey which presents a word picture of air travel between North Central and South America as it stands today According to the author 'America boasts the largest air transport system in the world the routes of which link every country but two in the three Americas something to think about and to talk about when the conversation turns to the superiority of European nations over this country in the matter of aviation

●

The ether once the basis on which was built the whole background of physics has received some severe blows since the end of the 19th Century The Einstein theory in which the ether has no part has among its supporters a majority of living physicists who are firm in their belief that there is no ether On the other hand are those whose belief is unshaken in the existence of an all pervading medium that is necessary to explain phenomena of light and electricity This last mentioned group has received another serious setback in the results of highly refined ether drift' experiments repeating those first performed by Michelson in 1887 and affirming his negative answer to the question of the existence of an ether A discussion of this recent work which has been carried on by the University of Jena with the aid of the Zeiss Works and a description of the elaborate equipment employed have been prepared for publication in our October issue

●

The cryptic (AP) which appears so often in the first line of newspaper stories is usually passed over with little or no thought of its meaning or significance Behind those two letters is a fascinating tale of big business as applied to the gathering and dissemination of news on a scale that baffles the imagination Think of one man through whose hands pass 100 000 words of copy daily think of thousands of miles of telegraph wires devoted solely to bringing the news of the world to the pages of your daily paper think of automatic telegraph transmitters and receivers by the hundreds and of constant endeavor to improve and perfect these machines so that they may operate at higher speed or with greater efficiency and then think that the two or three cents that you pay for your daily paper brings to you the results of the work of the gigantic organization behind it all the Associated Press The story of this far flung network of news gatherers who operate at the tempo of our modern world will appear next month

●

It has been said that in the stock yards they utilize everything but the noise and now the same degree of efficiency has been applied to rock drilling for building foundations and the like The noise is still there unused but a method has been developed for removing the dust which causes the deadly disease silicosis and conveying it to a settling chamber from which it is removed and sold Thus at one stroke has been accomplished two results Unhealthful dust has been abolished and a new source of revenue has been opened An article soon to appear will tell of this work

●

Just as chromium plating revolutionized certain phases of many industries so is it expected that tungsten plating newly developed will find its place in the industrial world Both types of metal depositing are due to the untiring researches of Prof Colin G Fink of Columbia University and from him we have obtained the story of his latest work The article is scheduled for publication next month and the results that grow out of the work as developments take place will bear careful watching for their influence on metallurgy

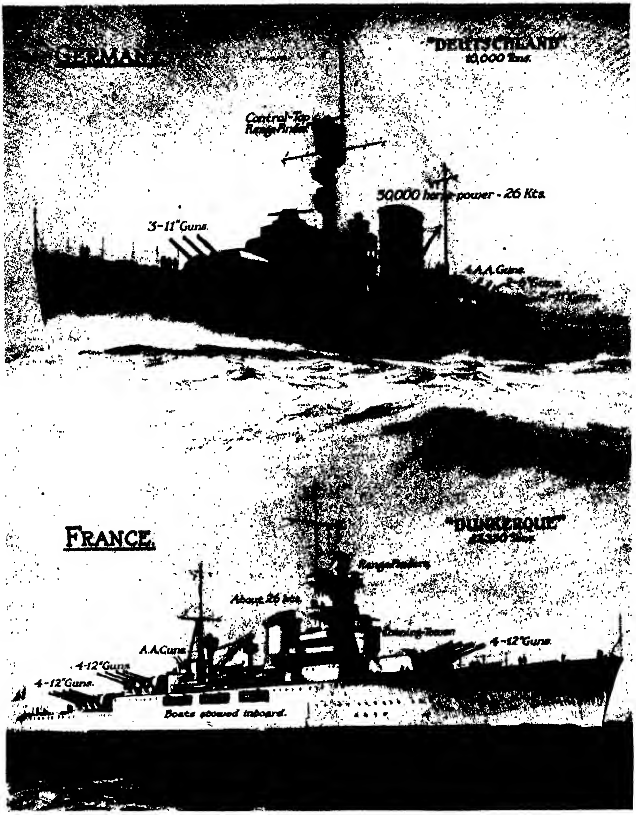
Orson D. Munn

Courtesy
Tech Engineering
News

MICHAEL FARADAY

ON AUGUST 29 of the pre will be exactly 100 year simple experiment in electricity was performed in a laboratory in London, an experiment which was seen later to have been probably as significant and as fruitful in practical way as any experiment ever performed. On August 29, 1831, Michael Faraday, then in his fortieth year and working at the Royal Institution under Sir Humphry Davy, after a period of profound reasoning wound two coils on a ring of iron, connected one coil with a battery and the other with a galvanometer, closed the circuit, and discovered that the needle of the galvanometer moved. This, in principle, was the first dynamo and in the space f 100 years since Faraday's brilliant inpiration the electrical industry, valued at bout 100 billion dollars, has grown quarely out of it. What Faraday had discovered, not accidentally but by deliberate periment after deliberate thinking, was the basic principle on which dynamos work.

This year the Faraday Centenary is being celebrated throughout the world of science. Steadily the fame of the self-educated Irish blacksmith's son whom Davy took under his aegis has grown and grown, and Faraday is regarded as one of the first few great scientists of all time. When someone asked Sir Humphry Davy to name his own greatest discovery he instantly replied, "Michael Faraday."



Courtesy The Illustrated London News

FRANCE'S REPLY TO GERMANY'S "POCKET BATTLESHIP"

IN GERMANY'S "Pocket Battleship," launched May 19 and named *Deutschland*, the designers have achieved the unheard-of in combining the gunpower of a small battleship with the speed of a cruiser in the tonnage of 10,000 allowed by the Versailles Treaty. Since she can out-hit at long range vessels of her own size and out-run more powerful ones, she is termed a threat to France. The *Dunkerque*, France's reply to that threat, will be heavier but just as speedy and much more powerful.

Courtesy Metro-Goldwyn-Mayer
Natives of Tahiti diving for ocean pearl, the iridescent mother-of-pearl shell of a bivalve living in these waters. This photograph was taken during the filming of "White Shadows of the South Seas"

A BUTTON INDUSTRY FROM OCEAN PEARL

By GRACE LOCKHART

WEARY of plainness, of severity, of simplicity in dress, Fashion called for a return to the picturesque, to feminine styles. And Paris said, Let there be buttons: buttons on suits, buttons on coats, buttons on dresses, buttons on hats, buttons here, there, everywhere. And Paris said, Let there be ocean pearl buttons, with the beauty of the deep sea, the brilliance of the sun's rays, and the iridescence of the rainbow, and it was so.

Exactly when buttons first made their appearance we do not know, but it was long, long ago. Certainly, they have been with us either as dress ornaments, or dress fasteners, or both for thousands of years. There are references to buttons in the literature of the ancients, and buttons have been found in the ruins of cities upon which the curtain of history fell centuries before Christ.

In the beginning, buttons were used mainly for ornamentation, loose and flowing garments not calling for them in a utility rôle. When modern clothing came into vogue, however, they became an indispensable dress accessory, combining utilitarian and decorative purposes.

In various periods of history and in various lands, buttons have been made of every conceivable material capable of being cut or turned or pressed, and styled in all manner of bizarre and beautiful patterns and colorings. At different times in accordance with the changing cycles of fashion, they have been pressed from casein, from potatoes, from seaweed, even from blood. They have been made of diamonds and rubies, of satin and velvet, of porcelain and jade, of every metal and with every alloy of every metal, and always of ocean mother-of-pearl.

Semi-civilized natives packing and weighing pearl shell in the Torres Straits off Australia

While buttons have come and buttons have gone, the pearl button has remained a constant theme in the history of dress ornament. Through the ages, mother-of-pearl has been regarded as a supreme raw material by button makers, for in the ocean pearl shell two essentials are combined: beauty of appearance and strength of fiber. Its loveliness is lasting, and its rich luster and delicate colorings are inherent and therefore permanent.

In deep rock or coral caverns on the sea-bottom, or on the sandy beds of still lagoons, the pearl shell is found—in those localities where can be found certain kinds of sea weed. The sun bathed waters of Australasia provide ideal conditions, and today the greatest volume of most valuable shell comes from the Australian fisheries. These fisheries, discovered only in the last 50 years, produce what is known as white shell. Because of its pure white coloring and great strength, this shell brings the highest prices, and is much sought after by manufacturers of high grade buttons.

Originally the only sources of pearl shells were the Red Sea and

Cutting pearl button blanks during the days—not so long ago—when button making was an individual enterprise

the Persian Gulf. It is interesting, and not widely known that the precious gem pearl is the product of the same marine mollusk which creates the ocean pearl shell; is, indeed, chemically and structurally the same. The difference is simply one of growth. The formation of the jewel is occasioned by the presence of some foreign object in the body of the animal against which it strives to protect itself by covering the intruder with layer upon layer of the infinitely fine tissue with which the shell is lined.

THE familiar pearl button, then, on your fine undergarment or shirt and the matched string of moon-white pearls at your jeweler's are of identical raw material. Producers of ocean pearl are more interested in the harvest of shell from which ocean pearl products are gleaned than in the numbers of jewels found. In his turn, the pearl diver is less interested in the jewel than in the shell, upon which his livelihood primarily depends.

In addition to the shell taken from the Red Sea, which is known as Egyptian, there is yellow shell found in the Sooloo Archipelago, a small dark shell found in Panama and Costa Rican waters, black shell from Tahiti, a variety of shells from the Dutch East Indies, and the abalone shell found along the Pacific coast of the United States. All these shells have different qualities and gradings, the pure white Australian shell being preeminent.

The ocean pearl shell which oftentimes measures 10 to 12 inches across—the individual shell frequently weighing as much as four or five pounds—is formed through long years of building. The material with which it is lined is a combination of calcium carbonate and a special material called conchiolin secreted by the pearl mollusk. The shell structure is made up of a large number of very fine layers of this chemical combination, each layer being 1/4000 to 1/6000 of an inch in thickness.

Under the microscope, the thin layers of pearl appear to curve and overlap in minute undulations as waves curl on a beach. The reflection of the minute undulations of the layer edges through these transparent waves produces the soft, rich luster, and rainbow iridescence peculiar to ocean pearl, while the unique laminated structure provides extraordinary strength.

These characteristics distinguish ocean pearl shell from the freshwater pearl mussel found in riverbeds, which is also used for buttons, but which by the nature of its structure—being of a different chemical composition, and formed in a solid mass instead of being built in layers—is inclined to brittleness and is lacking in permanent luster or iridescence.

Methods of ocean pearl fishing are different in the various localities. In the South Seas they are much the same as they always have been. A naked, black body poises on the edge of a tiny craft, in one hand a basket, in the other a sharp iron tool with which to pry the shells loose from their anchorage or to battle the sharks, plunges through the blue tropical waters, 30 to 50 feet downward, and rises with the prize, to rest, to breathe, and plunge again.

The machine age method of cutting pearl button blanks. Much skill is required to cut these properly so that there will be the least possible waste. Below is shown a large shell with the button blanks cut partly through

Many of the natives will descend only when protected by the incantations of shark-charmers, important members of the South Seas expeditions. Sometimes a rock is carried in the hands to make the descent less arduous, or the diver may stand on a stone to which a rope is tied and so be lowered to the treasure ground. In Australia, modern diving

equipment is used. The pearling luggers stay out practically the eight months' season, receiving their supplies from supply schooners.

The most important product of ocean pearl shell is, of course, the pearl button. America today is the center of the pearl button industry, and consequently the major market for pearl shell. Between five and six million gross of buttons are produced annually at a value of approximately 6,000,000 dollars, this production constituting a large percentage of the total output of buttons in the United States.

A nimble fingered worker feeds this modern convex backing machine. Blanks are placed, one at a time, into the chucks which pass under the grinding head

IT was not until 1855 that the trade in ocean pearl buttons was introduced into this country, the shells coming at that time mainly from the Far East. Thirty-five years later, the importation of pearl buttons had almost ceased, and in 1900 over a million dollars' worth of ocean pearl shells from Australian beds were imported.

The declared value of pearl buttons exported from Austria to the United States in 1886 was over a million and a half dollars. In 1900 it had fallen to 36,000 dollars, and Consul General Hirst reported: "The pearl button industry of Austro-Hungary which, in former years, occupied a prominent place among the flourishing industries of the Monarchy, has dwindled of late to such a figure that the pearl button can no longer be regarded as one of the principal exports to the United States. This may be attributed to the development of the industry in the United States."

Competition of foreign labor, which had once seemed a vital factor in an industry which in its European homelands called for hand labor, had, after all, proved of little consequence in America. An inventive nation had early begun the replacement, even in this industry, of men by machines.

Above: The machine which cuts the "fisheye" and drills the holes in buttons. *At left:* Hand button-turning lathe

Ocean pearl is essentially a material which calls for real craftsmanship. In central Europe and also in Birmingham, England, operators in the pearl button industry existed almost entirely independently. The trade was carried on by individuals working for the most part in their own homes, their equipment being a deft pair of hands and a lathe, but in a Twentieth Century New World, multiplicity of hands and lathes was not enough. Highly specialized machines were developed to meet the demand. Through advances in method, beauty of design and coloring have kept pace with volume, and from the decorative point of view, pearl buttons have

Part of the equipment necessary for the button polishing operations. Finished buttons are agitated in various solutions to bring out their luster

never been more varied or more ornamental.

Our knowledge of pearl button manufacture was inherited from Birmingham, England, originally the center of the pearl button trade of the world, a city, we are told, the very foundations of which are waste mother-of-pearl—the debris of pearl button manufactories; and from Austria Hungary from which country the old Bohemian button maker took himself and his lathe to our shores.

IN the old days with the old foot lathe which called for 12 separate operations, a skilled operator working from 10 to 14 hours a day could produce about 40 gross of buttons a week. Today the mechanical process is divided into five parts—cutting, splitting, grinding, facing, and drilling, each operation being handled by special operators. A well-known button manufacturer estimates that if one man could operate the machines now used, he could produce 650 gross of buttons in a week—an increase of over 1500 percent in production efficiency in less than 30 years!

However, although standardized manufacturing methods have made for phenomenal progress in the industry, deft fingers have by no means been entirely discarded. Considerable hand work is still necessary. In fact the button blank is handled individually in each process from start to finish.

After the shell has been graded, it is soaked in water for a period of one to two weeks. Then it goes to the cutting lathe. A high speed tubular saw, or drill, is used to cut the blanks.

The blanks, which vary quite a bit in size, shells from which they are cut varying from one twelfth of an inch to an inch and a quarter in thickness, are then classified for splitting into the proper thicknesses for the pattern desired. This work is done by hand with a splitting knife and steel hammer, some blanks being split into as many as six buttons. Here again skill must be used so that the maximum number of perfect blanks may be obtained. Mechanical means have not yet replaced the experience of the accomplished splitter.

After the blanks are reclassified, lathes equipped with abrasive wheels grind the face and back of the blanks to smooth, even surfaces. They are then fed into revolving chucks in which the pattern is made and the required number of holes drilled. This machine contains 20 chucks in an endless chain, in which the buttons are held. These open automatically to receive the blanks and close automatically in a continuous motion. The chucks pass under two separate turrets, the first one containing the tools for the facing of the pattern, the second one the drills for making the holes. An indexing attachment spins the chuck a quarter turn for four-hole and a half turn for two-hole buttons. When the last hole is drilled, the blanks are released at an average rate of 150 gross each eight-hour day.

THE next step is the polishing. Where formerly each button was polished individually by hand, bulk lots are now polished in tumbling barrels. A series of solutions is used, the first of which is water and pumice stone, the second water into which sulfuric acid is dripped at the rate of 10 to 15 drops per minute for the purpose of giving the buttons a hard lustrous finish, and the third hot water to which a solution of hydrochloric acid is added to bring out the pearly finish. Finally they are washed in soap and water and put into a last tumbling barrel containing sawdust where they are tumbled until they are dry.

Assorting is then done by hand, again by skilled workers who grade the buttons according to color and perfection.

Millions of ocean pearl buttons pass through this assorting room where keen eyed inspectors sort them out according to style, quality, and iridescence

OUR POINT OF VIEW

A Nine Days' Wonder

IF any one of us should be inclined to forget that we live in an age of speed, the amazing flight of Wiley Post and Harold Gatty in the *Winnie Mae* around the world in less than nine days would certainly bring us to our senses quickly. This flight, which is discussed in detail in the SCIENTIFIC AMERICAN Digest of this issue, set so many new records as to leave us well nigh breathless.

Called a "sporting proposition" by the pilot, Post, and the backer, F. C. Hall, the flight so stirred the imagination of the world that it has been called "the greatest since that of Lindbergh." Men high in governmental positions having to do with aviation, famous fliers, and executives of aviation manufacturing companies acclaimed it as "epoch-making," "an extraordinary tribute not only to the ability, fortitude, and endurance of the men themselves but also to the aircraft and engines of today," and as "another testimonial to the courage, dash, and daring of American aviators; it will have a far-reaching effect on the future of aviation." A display of sheer grit and determination, we add, and we extend our sincere congratulations to the intrepid Post and Gatty for their great achievement.

Much credit is also due the owner of the *Winnie Mae*, F. C. Hall, for the splendid spirit of unselfishness he has displayed in remaining in the background from the beginning of the flight on. Indeed, the whole performance was notably free from selfish aspects, noisome ballyhoo, and commercialism. For this fact, a world grown weary of publicity-seekers and raw exploitation, renders up its thanks.

More Speed in the Air

THE Schneider Cup races will be run on the Solent, in England, in September, and the United States will not be represented. That bare statement should be enough to shame every American who has the least sporting blood, patriotism, or business sense about him. If more is needed, however, it is necessary only to remind him that this country now holds two legs of the trophy, that a third victory would give it to us permanently, and that our best air speed, made by Lieutenant Alford Williams, is only 266 miles an hour against a world record of 357 miles an hour!

It is the contention of experts that great air speeds will never be attained except as the result of lessons learned in such experiments as those which culminate in the Schneider races. Sir Alan Cobham is quoted as saying that "Improvements in streamlining, diminution of air resistance, and superior engine design can be developed in no other way." That these factors are important, no one can deny, for all now recognize the necessity for air speed.

Some months ago it was reported that an association, the American Speed Foundation, had been formed to restore the United States to the Schneider contest. Its avowed purpose is to build a plane and train racing pilots for a supreme test at the next Schneider races in 1933. We wish them success but if, by any chance, they should run into difficulties, we hope, in fact we expect, that some other group or individual will take up this important problem of speed. We believe with Alford Williams that "without an immediate development of speed in the air, almost all American achievements in aviation will mean nothing!"

Chasing a Rainbow

SIR OLIVER LODGE is worrying again about the ether. Modern science believes there is no ether and never was, but Sir Oliver and some others still believe in it and want it diplomatically recognized by science. He now suggests an experiment which will restore the ether to "its inevitable place in the scheme of Nature."

The proposal is to set up an interferometer in an exceptionally intense magnetic field and measure the velocity of light with it. According to the classic ether theory the ether ought to be caused to flow along magnetic lines of force. Therefore light, which on the classic theory flows in the ether, would take a new velocity under the influence of the magnetic field. "A positive result," Sir Oliver says, "would break the prevailing monotony of negative results yielded by all recent attempts at bringing the ether to book. . . . "

There is not and never has been any evidence for an actual ether. To begin with, the ether was simply a convenient mathematician's hypothesis, a postulate, which in some way took root and grew into a tree without real excuse. Logic required an ether and the mathematicians, always facile, made one "out of some nothing," as God was supposed to have made the universe, according to Genesis.

Sir James Jeans likens the ether to the earth's equator—purely imaginary. Now no scientist ever has performed serious experiments with a view to laying hands on the earth's equator, tieing knots in it, seeing what it smells like, and so on. Further experiments to detect the ether seem almost as naive. Nevertheless it would be fun to see how Sir Oliver's experiment would work out. Somebody ought to try it, and then, if the ether is caught at last, perhaps a way can be found to catch some equally imaginary spooks and cut an identification mark in their ears.

Voices Across the World

WITH receivers clamped over his ears, President Hoover listened to discussions, questions asked, and answers given in connection, not with some momentous national problem but with what is perhaps a much more important international one—and across the Atlantic, at that! In such wise did the newspapers play up the use of the trans-atlantic radio-telephone during the international debt suspension talks early in July. In this particular case, the telephone served to awaken European diplomacy from its ages-old sleep, and the negotiations were speedily completed.

As explained in the article on page 182, the overseas telephone service has been in operation for only a little more than four years. But in this short time the service has been tremendously improved and extended; and business and commerce have adopted it as another link—and a vital one—in the "community of interests" chain that is rapidly bringing the nations together.

Right now when the whole world is discussing the possibility that the United States will modify her attitude of isolation, when people at home are urging a wider participation in international affairs, when the interdependence of nations is beginning to be recognized by the most hard-shelled "isolationist," it seems that the telephone is to play a large part in the period of better international understanding that is just around the corner. If the debt moratorium talks—via the radio-telephone across the sea—are any indication, the telephone is going to help a lot in promoting a neighborly spirit among nations.

WILD LIFE IN A FIRE*

By DUANE H. KIPP

Of the Wisconsin Conservation Commission

OSCAR WILDE'S thought-provoking line, "Yet each man kills the thing he loves," is nowhere more graphically illustrated than in three paradoxes of the outdoors. The first of these is the person who appeals frequently to the Humane Society to stop cruelty to animals, and yet who through carelessness with fire, will cause untold and extreme suffering to the creatures of the wild. The second is the hunter who devotes time and money to game propagation and protection activities, and yet who will carelessly flip a cigarette into brush, or leave a campfire burning, destroying by many thousands more game than he can produce. The third is the fisherman whose interest induces him to work faithfully and long at the frequently cold and unpleasant tasks of rearing and planting, and yet whose carelessness wrecks watersheds and poisons streams. It is the thoughtless and careless user of woodlands who destroys the thing he loves. Forest fires, for the most part, are not inevitable. They can and must be controlled. Figures compiled by the Conservation Commission indicate that barely 1 percent of the forest fires in Wisconsin are started by lightning, the only natural cause of forest fires. All others find their origin in human carelessness or maliciousness and are preventable.

Coot (mud hen) burned to death as fire swept over its marsh home

A story is told of a tenderfoot, watching a forest fire for the first time at close range, who wrinkled up his nose and commented on the unpleasant odor. His query to an old-timer working near at hand brought the laconic reply that it was "burnin' meat." If more of the causers of fire could visualize the effects of their carelessness, could smell "burnin' meat," the number of fires would soon diminish. They should hear the tales the fighters of fire can tell; they should know of the countless does that re-enter fresh burns and vainly search the hot ashes for fawns which had been safely concealed from all enemies but man's carelessness. Fire-fighters can tell of thousands of bird eggs baked crisp and lifeless in spring fires, and of mother birds seared and dead from heroic but vain efforts to protect their nests of eggs or young.

Fire's economic loss has been stressed for years. The public has been informed repeatedly of the destruction of forest growth, endangering of water resources, and the despoilation of natural beauties by fire. But so far, perhaps because of a lack of pictorial evidence, comparatively little has been said of the terrific and appalling slaughter of living things, large and small. Let one man be killed or even injured while fighting fire, and the news is spread broadcast, but in every forest, marsh, or field fire, death and destruction are dealt to uncounted lives and little is said or thought about it. Indeed, there is somtimes even skepticism as to whether game is actually killed.

During the summer of 1930, the worst forest-fire year Wisconsin has ever experienced since there has been organized forest protection, the State Conservation Commission made good use of several extremely bad situations and secured a most unusual series of pictures telling the story of forest fires and game. It is a lurid, horrible story of extreme suffering, agony, and death. Many of the pictures are revolting; none of them is pleasant. But in this they are true to the subject they portray. The extremely doubtful beauty of fire has received far more attention than it merits.

Fire burned off the roof of the main room of this beaver house

A FIRE destructive to game and fish occurred in September in parts of Wood, Juneau, and Jackson Counties in central Wisconsin. More than 120,000 acres of excellent game country were burned over in this single fire, which at its greatest extremity measured 97 miles in circumference. Much of the land in the fire area was open, grassy, dry marsh interspersed with ridges of oak, aspen, jack and Norway pine. These marsh lands had suffered from too enthusiastic and unintelligent drainage. Much of the country in this part of central Wisconsin has been so overdrained that irrigation is necessary.

The fire started in the center of a drained marsh area, in which there were no through roads. Many of the streams and drainage ditches in the district were dry. The peat soil which underlies most of these marshlands burned so readily that plowing furrows to check the fire was useless.

Before the fire, deer were very abundant in this part of central Wisconsin. During recent winters herds of 60 to 70 animals have been seen. The abundance of deer was due to the excellent character of the cover and a plentiful supply of food, a closed season for 15 years or more, and efficient enforcement.

*Text and photographs courtesy *American Forests* and the Wisconsin Conservation Commission.

Killed by warmed water, lack of oxygen, and excess carbon dioxide

More than a score of deer were found after the fire. Undoubtedly, these were only a small percentage of the number destroyed. Surveys made by the Conservation Commission determined that 60 percent of the deer surviving the fire had badly burned feet. One deer was found walking on its knees, and when put out of its misery it was found that both front legs had stiffened in a bent position and that the hoofs and foot bones had broken off. A dog was shot when caught in the act of killing a fawn which had badly burned feet. Another fawn was found dead in a ditch. A trap set near this fawn caught a coyote when he returned to his kill next day.

For several months following the fire, freshly dead deer were reported both in the fire area and in the district surrounding it. In November a lame deer was gored to death by a herd of cows. Disease resulting from the weakened condition of the deer, due not only to burning but to suffocation from gas and smoke, took its toll during the succeeding winter.

The most abundant game bird in this region was the sharp-tailed grouse. At first it was thought that most of these birds had died in the fire, but according to later checks, it has been determined that probably not more than 25 percent of the total population were actually killed. Prairie chickens, ruffed grouse, and quail suffered great losses.

Few rabbits were killed by the fire as they escaped into holes outside the peat beds. But the rabbits suffered particularly from hawks and owls following the fire, due to the lack of protective cover.

In this fire, as in most other fires, lack of oxygen, warmed and ash-poisoned water combined to kill thousands of fish. Dead fish were found in all parts of the drainage ditches and in the Yellow River, which flows through the burned area. Pickerel were hit the hardest. Many dead walleyed pike were observed. Dead suckers and minnows were seen in most of the ditches. In the Yellow River black bass and sunfish were found dead. Dogfish, ordinarily one of the hardest fish to kill by lack of oxygen, were found in a helpless condition, although not dead. Even frogs and crayfish died in large numbers.

The damaging effects of forest fires on game might be classified as direct and indirect. The direct includes the game birds, animals, or fish killed during the time of the fire, or dying as a result of injuries suffered. The indirect results are frequently more disastrous than the direct.

Fires cause dangerous concentration of game. In an area approximately three miles square on the eastern edge of Wood County, adjacent to the burned area, 93 deer were counted in a single afternoon early in the winter following the fire. This concentration was not the "yarding-up" as deer do not congregate in "yards" in mild winters. Sharp-tailed grouse, prairie chickens, and ruffed grouse have concentrated by the thousands along the ditch banks and in the few unburned "islands." Rabbits and other small animals have likewise concentrated.

THE very presence of large numbers of game animals or birds attracts predators. The predator situation becomes particularly serious after a fire because the mice and other normal food of foxes, coyotes, hawks, and owls are practically exterminated in burned districts. This makes the predators turn more than ever to game animals and birds.

Another disastrous indirect effect of forest fires is the destruction of food and cover. The beaver situation in this area is typical. Few beaver were actually killed in the fire because of their ability to escape by their water routes, but their food has been entirely consumed.

The Conservation Commission has established many feeding stations for birds in the burned area, equipping every station with automatic feed hoppers.

Fires have a serious effect on game reproduction. Many birds and animals, while not actually killed, are rendered impotent or inefficient because of weakened condition. Large concentrations of game, caused by fire, likewise have a harmful effect on reproduction because the individuals do not pair.

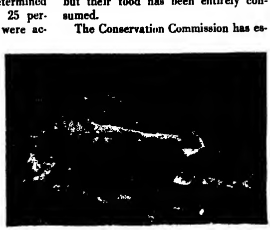
This one fire which burned in such excellent game country in central Wisconsin in 1930 may have been more destructive to animal, bird, and fish life than normal forest fires, but the results which have been related here tell the story of what happens in greater or lesser degree in every forest, marsh, or field fire.

The effect of fire varies according to the season in which it burns. Early spring fires are particularly disastrous to the mating activities of game birds. Fires later in the spring destroy nesting birds or young birds and animals. Fall fires play havoc with the food and cover necessary for the game to survive the approaching winter. Fires always do more damage to game than to game's predators, as these latter animals and birds are better able to take care of themselves than are the game animals and birds.

Baked body of a sharp-tailed grouse, after the fire had swept on

Statistics on fire causes show that a comparatively small percentage result from logging activities, indicating that men whose livelihood depends on the woods are more careful of them. Similarly there are usually fewer fires on Indian reservations than surrounding them. America's oldest outdoorsman is careful. Carelessness with fire in the woods marks the tenderfoot.

The whole effect of forest fires is probably more destructive to game than the sum total of all hunting and fishing law violations. Sportsmen can do nothing which will do more to perpetuate their sport than to prevent forest fires. America's out-of-doors is a heritage to keep, protect, and enjoy.



The burned feet of this dead doe tell an eloquent story of her sufferings in a forest fire

The field at Roosevelt Aviation School, showing the modern concrete and steel building housing classrooms, shops, and hangar

FLYING INSTRUCTION AS IT SHOULD BE

By GEORGE W. ORR
President, Roosevelt Aviation School, Inc.

THAT there has been remarkable progress in aviation is common knowledge to most people, but that there has been equal progress in flying instruction is not as generally realized. Proper education of the flier, however, contributes quite as much to the safety of flying as all other factors combined. There is little wonder then that continual study has been given to this phase of flying, and that the methods of instruction have become as scientific as other specialized fields in education, and subject to the closest scrutiny and regulation by our government.

In the earlier days of aviation the pilot was trained either by the government for one of the service branches, or the person desiring instruction attached himself to some operating organization and picked up such instruction as was at hand. Then a pilot here and there would manage to get the use of some kind of plane—anything that would fly—and advertise himself as an instructor, often dignifying such an operation by the name of a flying school.

This method of instruction is still practiced even in the light of modern school development. The practice is able to continue because such instructors have no organization expense, practically no facilities, and are, therefore, able to charge less than a properly organized, equipped and administered institution. Satisfactory results are sometimes obtained, because of the ability of instructor and pupil, but in general a sad list of accidents and fatalities has followed in the wake of such unorganized and haphazard methods.

A good flying school is just like any other good school, and the degree of proficiency of its graduates depends upon the facilities offered. Some of our most illustrious characters graduated from the old log school house and some of our excellent pilots are the product of "catch-as-catch-can" instruction, but it is no more logical to recommend such instruction for the student than it is to continue the log school house method of education. Under such conditions it is a matter of the survival of the fittest, and in flying this takes on a serious significance. There is little or no risk involved in the course of flying instruction by a properly administered school.

Realizing the significance of the above statements, the Department of Commerce, through its Aeronautics Branch, has given careful study to the problem of flight instruction and has issued detailed regulations (Aeronautics Bulletin No. 7-B). A certificate of approval is awarded to schools meeting government requirements. The work of such approved schools is carefully supervised. [See May 1930 SCIENTIFIC AMERICAN for details of these regulations and certificate awards. *Editor.*]

SINCE the writer is more intimately in touch with Roosevelt Aviation School than any other, he must be pardoned for using this school as an illustration of the modern flying school in action. Realizing the advantages both to the public and to the school of accepting the regulation of our government, Roosevelt Aviation School was one of the first approved schools and holds the highest license available from the government. This license includes all instruction necessary for private, limited commercial, and transport pilots.

There are three elements absolutely necessary to make safe flying, and these same elements may well be applied to safe instruction. These important factors are: A good pilot, a good airplane, and proper maintenance.

Perhaps the most interesting way to tell of the actual working of a flying school is to follow a student as he comes out for instruction. After enrolling, he is informed that he must pass a medical examination before a doctor appointed by the Department of Commerce for this purpose. This medical examination entitles him to receive a student's permit and also is sufficient to entitle him to a private pilot's license, when the test for this license has been passed.

Upon arriving at the school, he is delighted to find that while there is a great field set apart for instruction, it is also a part of commercial Roosevelt Field, the largest commercial airport in America, with more runways, more hangar space, and more resident commercial ships than any other field in the country. There are, in fact, two distinct fields, each comprising approximately 250 acres, one being on a lower level than the other but adjoining and connected by a ramp, so that planes

may taxi from one field to the other. The school field being reserved for instruction gives the necessary safety for the inexperienced pilot, and the close proximity of the commercial field gives the atmosphere and experience in regular aviation, which is of inestimable value to the student.

When the student is ready for his first flight; he is assigned an instructor who continues with him throughout the course of instruction, and who is chosen not only because of a special aptitude for instruction and long experience in the air, but because of his ability to enter into this close companionship of instructor and pupil with sympathy and understanding.

When the instructor and student are seated at the dual controls, the engine is "reved" up to see if everything is working properly. All ready? We close the throttle for a moment and signal to the mechanic to pull the chocks from in front of the wheels. Take it easy as we taxi our plane to the end of the runway and into the wind, which is the proper position for taking-off. Now then, "give it the gun!" We open wide the throttle and push straight forward on the control stick, in order to raise the tail and place our ship in a natural flying position. Our air speed indicator dials sufficient speed for the take-off, and soon we will learn to know by the feel of the ship just when the right moment arrives. Keep the ship straight with the rudder. We have our flying speed—pull back slowly on the control stick. Easy now, we're in the air! You scarcely know we left the ground at all. Six inches, five feet, ten, twenty, fifty feet. We continue with the control stick still slightly back until our altimeter indicates about a thousand feet.

Instruction in theory as well as practice is essential to rounding out the education of the fledgling

LOOK straight down. You won't be light headed. Many people get dizzy when they look down from a tall building, but there is little sensation of altitude in an airplane, just as there is very little sensation of speed, except when you are close to the ground.

We now have sufficient altitude, so we throttle down the engine to the proper cruising speed. It shortens the life of a motor to run it wide open too long. We take a glance at our instruments—altitude about right, speed about right, oil gage shows the proper pressure. Good. Let us fly level and straight—it's easy. Pick out some point on the horizon and point the nose of the plane towards it. As far as we are concerned the position of the horizon never changes regardless of our altitude. If the nose swings off to the right or left, bring it back gradually with the opposite rudder from the side to which the plane swings. It's like steering a boat.

Do not make hard work of flying. It is not necessary, for you'll only over-control as you did when you were learning to drive an automobile. Watch the nose of the ship. It is above the horizon. We are through climbing, so ease the stick forward and bring the nose down. That's it. The right wing is a little low, so "trim ship", as they say in the navy. That's the idea. Ease the control stick to the left—the aileron levels up the wings.

Now we are ready to try a turn. First, place the nose in a level position and bank and steer to the right by easing the control stick to the right and give it a little rudder at the same time. Now return the stick to neutral so that the bank won't increase. Our airplane is now turning. Now watch as I give it too much right rudder and not enough bank for this amount of turn—the tail of our machine skids around like an automobile skidding on a wet pavement, but there is so much room up here that little occurs. Feel that draft on the side of your face? You can always tell a skid that way. If we give it too much bank and not enough rudder for the bank, our airplane slips on the turn, slides down sideways, and we lose altitude. Feel the draft on the other side of your face? That's the side slip. You can always tell a slip by that draft. It takes practice to make perfect turns. It's simply a matter of co-ordination of the controls. It will come in a very little while, like learning to balance yourself on a bicycle. We come out of our turn to the right, we ease our rudder back to a neutral position and apply slightly opposite rudder and bank, if necessary, to bring our airplane back on a level keel. Coming out of a turn is just as easy as going into one.

WE h
utes now, which is long enough for the first try. Now, let's go back home. Follow closely what we do. We get into position so that we will come in against the wind. We close the throttle. Our motor will not stall, it runs idle, but we keep our hand on the throttle in case of emergency. Push the control stick forward, so that the plane goes into a glide, not too far forward so that it dives, and not too far back so that the glide is too shallow. That is about right—now just a nice gentle glide. We keep our wings level and steer directly into the wind.

As we approach closer to the airport, we look around carefully below and ahead to make sure that the field is clear for landing. As we approach the field, we look forward and to the right of the nose about a hundred and fifty feet ahead to judge our height from the ground. When we are about 15 feet from the ground, we begin to flatten out, as we are now, by easing back gradually on the control stick, keeping just above the ground as we decrease our forward speed. Watch now; this is important. We continue to pull back on

Working on real planes, the students are instructed in rigging

a speaking tube—but the student can not answer back!

The big thrill. The student, after thorough instruction in dual flying, is ready to take off on his first solo flight

our stick—back, back, back slowly to get the tail down, and our airplane lands itself on the wheels and tail skid at the same time. This is known as a three-point landing. We keep the stick back and the ship comes to rest, the tail skid acting as a brake. So ends our first flight! Thrilling, to be sure, but not with the anticipated thrill of danger—rather a thrill of exultation.

The student is always immediately supervised by his instructor. The training planes are equipped with dual controls, so that not only the student but the instructor has the controls at his command, and through a speaking tube the instructor can give directions all through the dual flights. From the very first flight, the student begins to gain experience at the controls, the first work being in straight and level flying. Next, climbs are attempted and then through gentle turns to glides. This is all very simple and is mastered quickly. Then, the most important part of the instruction begins; that of taking-off and landing. Each landing is different and the student spends as much time on this work, perhaps, as on all other training combined. As the student progresses, he is taught what to do in stalls and spins until the big moment arrives when he goes for his first solo flight. Three of these solo flights are made, with a check by the instructor between each. Then comes more instruction for 180-degree and 360-degree turns. More solo work on these turns, and then further instruction in figure eights and spirals. More solo work on these figure eights and spirals, and then the final check by the instructor before being ready to take the Department's test for the private pilot's license.

DURING this course of instruction, the student has taken the necessary amount of class work in ground school instruction so that by the time he has finished his flying training he is all ready for the examination. The approved school officials are very careful not to present any flier for examination, unless they are pretty sure that he has properly mastered his art, because it is necessary in order that approval may be retained that nine out of every ten students pass this test and receive the license for which he has applied.

Now the question is always asked, "How long does it take to learn to fly?" This is purely a matter with the student and depends upon how much time he can give to the work and how he applies himself in his studies. An interesting demonstration was made by Roosevelt School when it trained three young ladies, a matron, a business girl, and a college girl, to solo in one day. This is, of course, a stunt and is really too fast to proceed. The ideal time is about 21 to 28 flying days, which gives the applicant for a private license sufficient time to assimilate properly the instruction given and to do the necessary ground school work along with it. The time may be shortened to, say 14 days, and is often spread out over a number of months, which gives the student, if he has the time and money to sustain himself, the added advantage of more practical experience in mechanics and operations.

Flying school is over. The graduate pilot receives his license to fly

Behind the scenes of an aviation school everything is systematized for safety. A complete record is kept of the dual, solo, and ground-school time of each student. The planes and engines used in training are thoroughly inspected every 15 hours of flying time and the engines are thoroughly overhauled every 200 hours. After 300 hours the fabric is stripped from the fuselage so that every part may be thoroughly inspected. A complete log is kept of every engine and plane, showing time of flight, and work done.

MANY of the students now enrolled in the better schools are interested in aviation only as a sport. Flying is a thrilling and absorbing sport and is just as safe as any other, when the flier has been properly and adequately taught the essentials of safe flying. These men, depending on their means, either purchase planes for themselves or in company with a group of private pilots as a flying club. Many commercial operators furnish space for storing and servicing these planes just as a garage does. Considering the space occupied by a plane, in comparison with an automobile, and the use of the costly airport facilities which go along with it, the charges are most reasonable, running usually upward from 25 or 30 dollars a month, according to the size of the plane. Other students are learning flying as a profession. Even though there is an abundance of graduate pilots available at present, the thoughtful young man or woman realizes that as in any other profession, graduation is not all that is necessary in securing a good position. It is just the beginning. The inexperienced graduate of today will be the experienced pilot of tomorrow when the expanding demands of a growing industry require their services.

HOW YOU ARE INFLUENCED BY COLOR

By SOLON R. BARBER

IN o other age has color played so important a part in buying and selling. The modern woman wants her frock to match the color scheme of her motor. She chooses dresses to suit her mood. She achieves color harmonies in the foods she serves and the dishes she serves them in. Even men have surrendered to the newer spirit and are now using more color in their clothes, homes, and offices. Our skyscrapers are built in such a manner as to give a distinct color effect, even to blend or contrast with their surroundings.

Modern shops are designed to appeal to the buyer's increasingly active color sense. Wise merchants, in tune with their time, are studying the science and art of color so as to compete successfully with their modern business rivals. Show-case displays are often masterpieces of color design and harn

Color is particularly important ı the case of foods. The average housewife buys much of her food in cans, but she has not forgo what to expect in the way of c in canned foods.

So distasteful are abnormally colored canned foods to the discriminating, color-conscious housewife that the Federal Food and Drug Administration, in its enforcement of the national pure-food laws, has established minimum color standards for certain of these products. Few like to eat grey or brown canned peas or brownish canned apples and most of us have certain ideas about what other foods should look like. But of all canned foods, the tomato probably ranks first so far as the color desired is concerned. There are yellow tomatoes, wholesome and nutritious, but the average American consumer prefers his tomatoes, whether canned or fresh from the vine, to be just the right blushing red. Due to the enactment recently of the Canners' Bill, an amendment to the Food and Drugs Act, it is incumbent on the Administration to set a minimum color standard for canned tomatoes and perhaps for other products as well, if they are not to fall below the United States standards, the establishment of which is provided by this amendment.

The Canners' Bill provides that the Secretary of Agriculture may establish and promulgate definite standards of quality, condition, and fill of container for all canned foods except canned milk, meat, and meat products. Now, color is a very important factor in the quality of a food. The Secretary has already promulgated the "normal color" definition for canned peaches as "a general

A government chemist measuring the color values of tomato catsup with Munsell disks

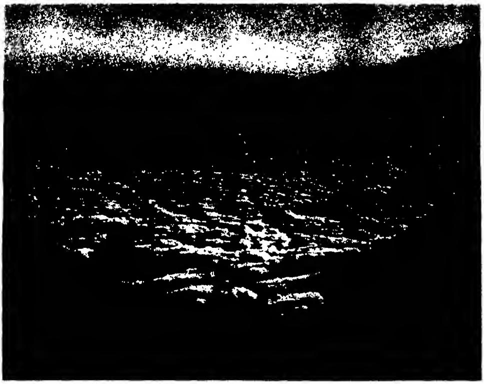
effect of yel ... nned pears as "a ger nslucent, yellowish white color,' peas 'a general effect of gre xceed four percent by c... of discolored peas, such as brown or brown-spotted peas."

Setting color standards for these three foods was comparatively easy, but tomatoes are "something else again." The Administration is about convinced that the following wording very nearly describes a minimum color standard for this fruit: "The fruit shall be considered normally colored when a sample, at least one inch deep, of the homogeneous pulped meats shows a red color containing at least 58 percent red and not more than 37.3 percent green, in terms of the three primary color distribution curves of the Optical Society of America, referred to Abbot-Priest standard white light." This standard is subject to change, however. These percentages do not, of course, refer to the proportion of red to "green" (unripe) tomatoes, in the popular sense. They ı rather the precise physical ter sary to define color accurately in a legal standard.

It is, however, out of the question for every canner and food broker to purchase a color-measuring instrument costing between 1000 and 2000 dollars, and requiring th of a trained physicist for ation. Fortunately, there a able certain commercial devic for measuring color which are sufficiently accurate for practical purposes, which can be purchased for a reasonable sum, and which can be operated by a person does not hold a Ph.D. degre physics. Among such devices, the Munsell system of color disks has been found useful in judging whether a certain can of tomatoes does or does not meet the mini- color requirement of the standard. The dev sentially of a horizontal circular table, which can be revolved rapidly by motor. A multiplicity of colored -dboard disks are available bearing various cabalistic devices which, to the initiated, describe their particular color value. The rapid revolution of the tabl causes a blending of the variou exposed colors into a single colo sensation. By a proper select and arrangement of color disks, the color of any material may be matched with considerable exactitude if it is brought close to the revolving table i such a manner that the two surfaces lie in the same plane and are equally illuminated by standard white light striking at an angle of 45 degrees. An eye-piece comparator brings the two color fields to the eye as the two halves of a circle, so that an accurate comparison is made easy.

After a satisfactory match has been obtained the operator has only to read off at the graduated circumference of the table the percentages of the disks.

For rapid, every-day cannery use, no doubt an even simpler method of color comparison will be employed. It seems probable that for practical purposes, the canning trade will obtain for itself color cards which reproduce the minimum color called for by the standard, which can be used in making reasonably accurate comparisons.



When the clouds roll in at low level around the base of Mount Wilson, completely cutting off the world below, those who work at the Observatory on the mountaintop experience the feeling of being suspended in space beneath the stars. But at night, if there is no fog to hide the lights of the communities of Pasadena, Los Angeles, and Hollywood, these

IS INTERSTELLAR SPACE WHOLLY EMPTY?

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

NEARLY 30 years ago Hartmann, while studying the spectrum of Delta Orionos, one of the stars in Orion's belt, made a surprising discovery. The star is a binary with a period a little less than six days and its orbital motion caused the lines of the spectrum to shift alternately to the red and to the violet in the familiar fashion. One line, however, the *K* line of calcium in the violet, behaved quite differently from the rest. While the other lines were broad and hazy, it was sharp; and while they shifted to and fro, it remained unaltered in position. The sharpness indicated that this line was absorbed by a more rarefied gas than that which produced the others, and its fixed wavelength that this gas did not share the motion of the star.

Evidently a gaseous mass of low density must be somewhere between us and the star, and not so near it as to be churned into motion by the revolution of the star and its companion in their orbits. This gas must consist of, or at least contain, calcium vapor and it was therefore supposed at first that it must be fairly near the stars so that their radiation kept it hot.

But a few years later Slipher, who had detected similar "stationary" lines in the spectra of several other stars, pointed out that the "calcium clouds" did not share the motion either of the sun or of the stars, but that their observed velocities showed that they were in almost all cases practically at rest in space. He suggested that the atoms which absorbed the lines formed part of exceedingly rarefied clouds in interstellar space.

A FEW additional lines of the same sort were soon discovered—the other violet line of calcium (*H*, which is often obscured by strong hydrogen lines close by) and the yellow lines of sodium. All these can be observed only in the hottest stars, for the spectra of the rest contain strong calcium and sodium lines of their own which quite drown out the narrow though sharp "detached" lines.

Extended investigations by many workers have fully confirmed the explanation and there is no longer any doubt that interstellar space is occupied, at least for thousands of light years from the sun, by metallic vapors of very low density.

This raises another difficulty. The sodium atoms which absorb the yellow lines are neutral, but the calcium atoms which produce *H* and *K* must be ionized. There is a strong line of neutral calcium in the blue but this does not appear as a "detached" line in the stars.

Why should the calcium atoms be torn apart in this fashion? For each ionized atom there must be a free electron. Sooner or later these wandering electrons must collide with the charged atoms and, since there is a powerful attraction between them, they will recombine. Even if the interval between collisions was many years, a century or so would see practically all the atoms back in the neutral state unless something kept splitting them up again.

This is one of the many puzzles which have been solved by Eddington. What does the trick is ultra-violet light from the hotter stars. Such light, falling on an atom, can tear one electron off and send it flying away at a high speed. Out in interstellar space far from any particular star the light is very faint but its atom-splitting power is as great as ever. The number of atoms per million which are ionized in a given minute will be small, but the process will still go on till it is balanced by recombinations at chance encounters.

It is very easy to pull one electron off a sodium atom and very hard to remove the second. So most of the sodium atoms will be minus one electron (singly ionized). Practically none will lose

lie spread out below in a vast sparkling panorama visible clear to the Pacific Ocean. To some extent the city lights now interfere with astronomical photography, the diffused illumination reflected from the sky affecting the plates during long exposures. These pictures were taken by Dr. Ferdinand Ellerman of the Observatory, whose hobby is fine photography

a second electron and few will be neutral. But for calcium it is pretty easy to remove a second electron after the first is gone, and very hard to get the third off. The great majority of the calcium atoms will be doubly ionized and a few will be singly ionized (and absorb the *H* and *K* lines). An atom in this state is far more likely to be torn apart again by starlight than to pick up another loose electron, hence the absence of the lines of neutral calcium is explained.

A number of other elements—hydrogen, magnesium, silicon, and perhaps iron—may behave in the same way but their characteristic lines are in the far ultra-violet where the opacity of the earth's atmosphere keeps us from learning anything about them.

How these metallic atoms got loose in space is another problem. We know that masses of gas are sometimes blown clear away from the sun as eruptive prominences, and calcium is the most prominent constituent. But whether all the interstellar gas has been ejected from the stars or whether much of it was there in the first place, no one knows.

An important series of papers by Struve of the Yerkes Observatory has greatly extended our knowledge of this interstellar gas. He has observed detached calcium lines in the spectra of more than 300 stars and finds that they are always present when there are no stellar lines to block them out and when the star is far enough away. For the nearer stars—that is, those which are only a few hundred light years away—the "interstellar" lines are faint. For remoter stars they grow stronger and stronger. For example, stars of the seventh and eighth magnitudes with B-type spectra must on the average be much remoter than third magnitude stars of the same spectral type and they show much stronger calcium lines.

To put these results into numerical form is still difficult, for it is hard to find any good way of estimating these great distances. But Struve's discussion indicates that the stars in which the detached lines are strongest may be as much as 20,000 light years away.

It may be possible in future to use the strength of these lines to find the distances of remote stars. There is only one serious difficulty: the clouds of calcium atoms appear to be very widely spread through space but they may be thicker in some regions than in others. There is already some evidence that this is the case and it may be that future studies will enable us to map out these clouds of almost inconceivably thin gas.

ONLY rough estimates of the actual density of this gas can yet be made, but these are remarkable enough. The latest study by Unsöld, Struve, and Elvey, indicates that within a few thousand light years of the sun there is on the average one absorbing calcium atom in every two or three cubic meters. Only a few small fractions of the atoms are in the singly ionized state which absorbs the observed lines. Existing calculations indicate that the proportion is something like one in a hundred thousand. This gives (closely enough) about one calcium atom per cubic inch.

It is very hard to realize what this infinitesimal density means. If there was nothing else but calcium, then it would require 60,000 cubic miles to contain one milligram of material, and more than a million cubic miles to weigh as much as a cubic inch of air!

How many atoms of other sorts are present we can only guess. Probably enough to make a total density ten times as great. This estimate would make the total quantity of matter in interstellar space greater than that which is concentrated into the stars, and is likely to be too high rather than too low. In such a gas, according to Eddington, an atom would on the average move in a straight line for about seven years before being deflected by collision, and during this time would travel farther than the distance from the sun to Jupiter.

Strangely enough the gas, though in the depths of interstellar space, would be hot and not cold. The temperature of the gas depends on the average velocity with which its molecules or atoms move. In the present case this motion is caused mainly by the impacts of the free electrons. These are torn from their apparent atoms by the influence of ultra-violet light and set moving at a speed which depends on the quality and not the brightness of the light. Calculation shows that it will be high, and that when the impacts on the atoms have done their work their average rate of motion will correspond to a temperature about 10,000 degrees Centigrade. The gas is so excessively rarefied that a solid body immersed in it would not be perceptibly affected. The extreme infrequency of impacts of gas atoms on its surface would more than compensate for the violence of those which occurred, and no trouble would follow.—*Princeton University Observatory.*

The locksmith's shop is filled with a million or so blanks and keys. The exceedingly ingenious machines duplicate warded, pin, and single and double bitted keys. Every worker is an expert

A DAY WITH A LOCKSMITH

By ALBERT A. HOPKINS

Author of "The Lure of the Lock"

AS soon as the human race began to acquire property of any kind, the "stick-up" man and the racketeer entered the picture and people began to devise methods of safeguarding worldly goods. Eventually the lock was invented and we find references to both locks and thieves in both the Bible and the Odyssey of Homer. Where there is a lock there is a locksmith. Unfortunately, we do not know who was the first locksmith, but we can visualize him as a good mechanic and an honest man. The locksmith of today has suffered from his contact with the machine age. There are still, however, a few hundred men in the United States who are in reality master locksmiths. The true locksmith does not depend altogether on key duplicating machines and he must be able to pick a lock or open a safe. The writer has been fortunate in having been associated with a master of his craft in the examination and repair of the only large lock collection in the world and some of the angles acquired will probably be interesting to our readers.

The store of the locksmith does not look unlike that of the hardware merchant, for he sells locks as well as services. The shop is rendered rather picturesque by the immense festoons of blanks. In the shop shown on this page there are more than a million blanks in hundreds of shapes. If a proper blank cannot be found, it must be made by hand. A duplicating machine for making keys may cost only a few dollars or two or three hundred dollars.

This unique machine makes four types of keys at one time and removes cuttings

One unique type which we illustrate makes four different kinds of keys at one operation on the various "set-ups." In a large shop four or five different machines are in constant operation. Mr. Charles Courtney's lock store which we illustrate is almost a show place in West 125th Street, New York City. It is crowded all day with customers who have "lock trouble" or are "key shy." A census of one day's business was made for the writer and the facts are as follows:

Made 264 keys for 43 customers, installed four concealed locks on money cars, changed combinations on ten house locks, made keys for six trunks, opened up two store door locks where keys had been lost, changed combinations on two safes, fitted keys to locks or repaired locks on 45 cars, installed or repaired ten door closers. In addition scissors and skates were sharpened, saws were filed, and a few other odd jobs were done.

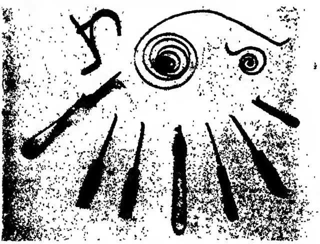
Mr. Courtney is fond of getting up lock statistics and he recently made a computation for us of the numbers and types of keys carried

by the people of Greater New York. The number of keys is 21,440,654 weighing 525,455 pounds, while 12,755,371 keys are kept at home and 6,788,368 kept in hotels, clubs, et cetera. What shall we say about 23,000 handcuff keys? Some of the mystery is taken out when we recollect that New York has 19,661 policemen.

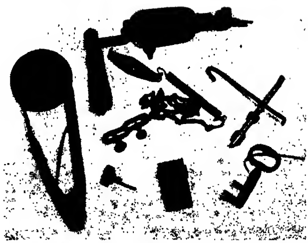
The locksmith is often asked to do questionable jobs but it is rarely indeed that he succumbs to temptation. The tools used by locksmiths are often made for the job and every one of the specialized mechanics have their own little pets which they are fond of showing to their fellow craftsmen. We illustrate two groups of such tools which show clever adaptations of mechanical principles and after looking at them we wonder if there are any "Raffles" in reality.

Above: Mr. Courtney is showing how to drill a hole so as to get at the tumbler of a combination lock. An electric drill is often used by an up-to-date cracksman. *Upper right:* It takes two hands and plenty of skill to pick any good lock

Left: The right way to open a door is to get an honest locksmith to pick the lock. It requires great skill and experience and special tools and no amateur need apply. *Upper:* The trail of the "jimmy." *Right:* The wrong way to open a door—jimmying a loft door is also very hard work



Regular lock picks and emergency picks made out of knives and forks. Clock springs are often useful in picking locks. Even the coat hook as a lock pick once saved a woman's life. She had a seizure behind folding doors. A locksmith may use more than a dozen "picklocks"



At left is a depth gage. At top will be seen a "tumbler rattler" for raising pins in a pin-tumbler lock. The "gear" belongs to it. Upper right hand device is an extemporized key to open a "bull" pen. Key is pick lock, metal ribbon being fed through barrel to locate the tumblers

THE PERSPECTIVE OF MODERN PHYSICS*

By PAUL R. HEYL

FOUR years ago an English clergyman, the Bishop of Ripon, perhaps not altogether humorously, suggested a scientific holiday, a closing of all laboratories for ten years to permit catching up with discovery. His suggestion was received in scientific circles with proper amusement, yet it was recognized that the Bishop had expressed perhaps more aptly than he could in any other way the situation in which physical science found itself.

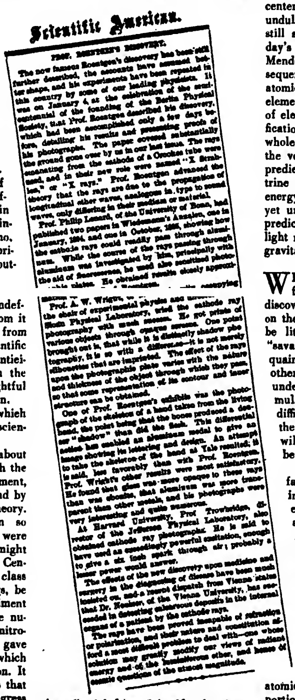
For a third of a century, starting with the discovery of X rays in 1895, there had been such a rush of discovery as physical science had never before experienced. So rapid was the accumulation of fact and theory that it became difficult for most persons to maintain the pace, and the procession dwindled down to a few leaders who, whatever may have been their private state of mind, showed no outward signs of distress.

SUCH a situation cannot last indefinitely. Like a commercial boom it must sooner or later reach a term from natural causes. In suggesting a scientific holiday the Bishop was merely anticipating in a rather extreme form the outcome which he and other thoughtful persons saw must inevitably happen.

What natural causes are there which may act as a brake on too rapid scientific discovery?

Scientific discoveries may come about in three ways: by accident, as with the X rays; by induction from experiment, as with the discovery of argon; and by suggestion or prediction from theory.

Accidental discoveries happen so rarely that if scientific progress were to depend solely on these its rate might be something like that of the 18th Century. Discoveries of the second class must also, in the nature of things, be rather infrequent. Years of experiment were necessary to accumulate the numerical results on the density of nitrogen from various sources which gave to Rayleigh and Ramsay the hint which resulted in the discovery of argon. It is to discoveries of the third class that we are chiefly indebted for the progress of physical science since the opening of the 19th Century. It is true that in the early stages of the development of a science, when theory is weak and has but little experimental basis to direct it, progress must depend principally upon accidental discovery; but when theory has reached a certain stage of perfection it takes hold, and thereafter sets the pace.



Scientific American.

PROF. ROENTGEN'S DISCOVERY.

The now famous Roentgen's discovery has been still further described, the accounts have assumed better shape, and his experiments have been repeated in this country by some of our leading physicists. It was on January 4, at the celebration of the semi-centennial of the founding of the Berlin Physical Society, that Prof. Roentgen described his discovery, which had been accomplished only a few days before, detailing his results and presenting proofs of his photographs. The paper covered substantially the ground gone over by us in our last issue. The rays emanating from the cathode of a Crookes tube were used, and in their new role were named "X Strahlen," or "X rays." Prof. Roentgen advanced the theory that the rays are due to the propagation of longitudinal ether waves, analogous in type to sound waves, only differing in their medium or material.

Prof. Philip Lenard, of the University of Bonn, had published two papers in Wiedemann's Annalen, one in January, 1894, and one in October, 1895, showing how the cathode rays could readily pass through aluminum. While the course of the rays passing through aluminum was investigated by him, principally with the aid of fluorescence, he used also sensitized photo- ... He obtained results closely approxi- ... Roentgen. ... occupying

Prof. A. W. Wright, ... physics and direc- the chair of experimental physics, tried the cathode ray Sloan Physical Laboratory. He got prints of photography with much success. One point various objects through opaque screens. brought out is, that while it is distinctly shadow photography, it is so with a difference—it is not merely silhouettes that are imprinted. The effect of the rays upon the photographic plate varies with the nature and thickness of the object through which they pass, so that some representation of its contour and inner structure can be obtained.

One of Prof. Roentgen's exhibits was the photograph of the skeleton of a hand taken from the living hand, the point being that the bones produced a denser "shadow" than did the flesh. This differential action has enabled an aluminum medal to give an image showing its lettering and design. An attempt to take the skeleton of the hand at Yale resulted, it is said, less favorably than with Prof. Roentgen. Prof. Wright's other results were most satisfactory. He found that glass was more opaque to these rays than was ebonite, that aluminum was more transparent than other metals, and his photographs were very interesting and quite numerous.

At Harvard University, Prof. Trowbridge, director of the Jefferson Physical Laboratory, also obtained cathode ray photographs. He is said to have used an exceedingly powerful excitation, enough to give a six inch spark through air; probably a lesser power would answer.

The effects of the new discovery upon medicine and surgery in the diagnosing of disease have been much insisted on, and a recent dispatch from Vienna states that Dr. Neusser, of the Vienna University, has succeeded in detecting calcareous deposits in the internal organs of a patient by the cathode rays.

The rays have been proved incapable of refraction or polarization, and their nature and constitution afford a most difficult problem to deal with—one whose solution may greatly modify our views of radiant energy and of the luminiferous ether, and hence of cosmic questions of the utmost magnitude.

An editorial from *Scientific American*, February 8, 1896, one month after the announcement of the discovery of X rays. Note closely the final paragraph

As instances of discoveries of the third class we may mention conical refraction and the bright spot at the center of a shadow, predicted by the undulatory theory of light when it was still struggling for recognition; Faraday's production of induced currents; Mendelejeff's periodic law and its consequences, notably in the correction of atomic weights and the discovery of new elements; the prediction by Maxwell of electro-magnetic waves, and its verification by Hertz, upon which rests the whole of modern radio communication; the verification of light pressure, also predicted by Maxwell; Einstein's doctrine of the equivalence of mass and energy, generally accepted, though as yet unverified by experiment, and his predictions of the curious behavior of light rays and spectral lines in intense gravitational fields.

WITH the possible exception of the first class these different modes of discovery call for special qualifications on the part of the discoverer. He must be literally what the French call a "savant," a knowing man, well acquainted with what has been done by others, with a good perspective and understanding of our store of accumulated knowledge. And the more difficult it is to acquire this grasp of the past and present, the less likely will it be that new discoveries will be forthcoming in the future.

An accumulation of undigested fact and theory is an ever increasing drag upon progress which must eventually reduce its pace to that at which assimilation is possible. I think that there is evidence that such a slackening in pace is now beginning.

Not that there is any diminution in the amount of scientific activity; the volume of publication shows no apparent decrease. It is the nature of the articles published that is significant. In the journals of today we find less attention paid to atomic physics and an increasing proportion of articles dealing with a general refinement of our knowledge, a filling in of outlines previously sketched, rather than with explorations in new

*Publication approved by the Director of the Bureau of Standards of the United States Department of Commerce.

territory. The atmosphere is suggestive of 1890 rather than of 1920. This movement seems to be even more strongly marked abroad than in this country.

As a consequence of these changing conditions we find ourselves, if not exactly in such a scientific holiday as suggested by the Bishop, at least in the initial stages of something which may serve equally well. For the first time in a generation an opportunity offers to set our accumulated knowledge in order and to improve our perspective of it.

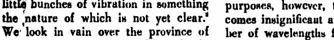
Perhaps the most striking feature of modern physics, both from its strangeness and its ubiquity, is the radical change in the nature of the concepts with which we deal, a change away from materialism and toward the insubstantial. The realities of today were the intangibles of the last century. Matter itself, that cornerstone of physical science since time immemorial, has lost its individuality, and is now regarded as merely another aspect of that Protean concept, energy.[1] The atoms of which matter is composed are, as de Brogile and Schrödinger tell us, nothing but little bunches of vibration in something the nature of which is not yet clear.[2] We look in vain over the province of physics for something tangible and substantial. Nothing remains but the shadows of former realities.

HOWEVER, we must make the best of the situation in which we find ourselves, especially since we have brought it upon ourselves by our own curiosity. Shadows may be insubstantial, but at least are they not definite and sharply defined?

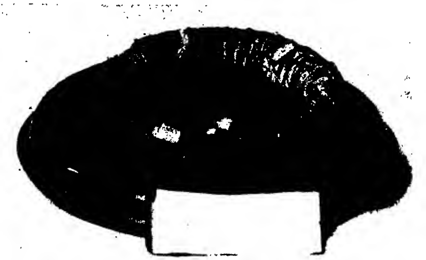
At this point Heisenberg, seconded by Bohr, says "No!" They tell us that our concepts are not only insubstantial but vague and indefinite as well; that, for example, we can never hope to know accurately how large an atom is *and* how rapidly it is vibrating. We may know one or the other to any reasonable degree of accuracy, but not both; and the curious fact is that an attempt to improve the precision of our knowledge of one of these attributes of the atom automatically interferes with our obtaining a like knowledge of the other.

To understand how this can be we must consider the Schrödinger atom in some detail.

One way of representing this atom conveniently is as shown just above.



A conventional model of the wave atom, an exact model not being available as in the case of the familiar Bohr atom



Courtesy Tyrus-Rochester

The original iron ring and coils used by Faraday in working out the principle of induced currents, "one of the most fruitful concepts of the human mind"

The atom consists of a small group of waves whose amplitude diminishes as we pass outward in any direction from the center of the group, but never disappears permanently and entirely. In other words, the atom, strictly speaking, has no definite boundary. For practical purposes, however, the amplitude becomes insignificant at a moderate number of wavelengths from the center of the group.

THIS dying out of the waves is due to interference. The group consists of waves of a number of different lengths and vibration frequencies, constituting what is called a frequency band. By their mutual interference these waves cancel each other out more or less completely at a moderate distance from the center of the group. The diminution in amplitude is more rapid if the frequency band is wider; that is, if the group contains a greater variety of waves. This more rapid diminution in amplitude shows itself in an increased sharpness of definition in the boundary of the atom.

But it will be noted that this increase in precision of size is accompanied by a corresponding decrease in precision of frequency of vibration. To make the boundary sharper we must widen the frequency band by including waves of longer and shorter lengths than those in the original atom. In the spectroscope, the less definitely bounded atom would give the sharpest lines, while the more sharply bounded atom would give a spectrum made up of rather wide, fuzzy bands whose wavelength could not be accurately determined.

This see-saw relation has been shown by Heisenberg to hold good between other pairs of properties of atoms and electrons, such as position and velocity. The general law thus developed is known as the principle of indeterminacy. It asserts that in general we can measure to any desired degree of precision only one half of all measurable quantities, and that the precise determination of this half automatically renders less precise our knowledge of the other half.

This indeterminacy is most noticeable in measurements involving atoms and electrons, but theoretically it holds for large bodies as well. To determine the motion of the moon we observe the light reflected from its surface. But in the act of reflection the light exerts a very small pressure. In consequence, the motion of the moon must be accelerated or retarded as it is illuminated on one side or the other by the light from the sun. Only in perfect darkness would the motion of the moon be unperturbed, and then we could not observe it at all.

THIS indeterminacy, though utterly negligible for large bodies, becomes of importance when we are dealing with atoms and electrons. Though we do not observe them by reflected light we do depend for our knowledge of their behavior upon their interactions with other similar bodies, which process, of course, involves mutual disturbances in both parties to the action. And it is quite possible that an atom or an electron may be seriously perturbed by even a single quantum of energy.

The importance of the principle of indeterminacy is undeniable, but we must be careful not to read too much into it. In some quarters it has been regarded as overthrowing the philosophy of determinism.[3] This, I think, is going farther than is warranted.

Determinism is an old philosophy, and pages of polemic have been spent upon it and its opposite, free will, until

[2] Heyl: *Scientific American*, July 1928, "What Is an Atom?" November 1928, "Wave Atoms."

[3] Eddington: "The Nature of the Physical World," page 228.

the stock arguments pro and con have been worn to tatters. But the interest in the subject is perennial, and any chance of a new argument is eagerly seized upon. Briefly speaking, determinism asserts that nothing is due to chance, but that there is a definite cause for everything that happens, and that this series of cause and effect runs back

Science Service Photo
Dr. Werner Heisenberg of the Theoretical Institute of Physics

in an endless chain, so that if it were possible for us to acquire a perfect knowledge of the universe at any instant we could (at least in theory) predict its state at any future time.

This doctrine is generally regarded as harmless as long as it is limited in its application to inanimate Nature, but when the determinist attempts to include the actions of sentient beings in his philosophy he inevitably arouses active opposition on the part of some of these beings, who maintain that their actions are governed by free will, and that they can make an independent decision as to their course of action which could not have been predicted from past conditions.

The issue thus raised has been a source of contention for centuries. The principle of indeterminacy has lately been dragged into the conflict on the ground that it denies the possibility of our ever attaining a sufficient knowledge of everything necessary to predict the future. The fallacy of this argument is that it quietly and unwarrantedly shifts determinism from an objective to a subjective basis. Historically, determinism is objective; that is, independent of the presence of an intellect to follow up the process of cause and effect. It loses all meaning as a general principle of Nature when placed on a subjective basis. The principle of indeterminacy, on the other hand, is essentially subjective. Its name is perhaps unfortunate as suggesting the older philosophy. It might perhaps better be called the principle of complexity. In the case of the Schrödinger atom the more definite the diameter the more complex is the constitution. When this complexity reaches a certain degree we call it, subjectively, "indeterminate;" but no matter how complex the result, it is objectively perfectly determined by a more or less complex set of causes.

We have seen that, thanks to de Broglie, Schrödinger, and Heisenberg, our concepts of physical entities have become not only insubstantial but ill defined and vague, from our point of view. But though matter may have been merged with energy, and though position and velocity interfere with each other's measurement, can we not still find something unalterable in the concepts of space and time?

BUT even here we meet with disappointment, for Minkowski tells us that these concepts have gone the way of matter and energy. "From this hour, space in itself and time in itself sink to mere shadows, and only a kind of blend of the two retains an independent existence."

This blend of space and time is essentially four-dimensional in its nature. Time was (and not so very long ago) when interest displayed in four-dimensional geometry by any one but a pure mathematician was sufficient to render him an object of suspicion; but safe in the 20th Century, Minkowski could utter the foregoing words, and Einstein, Jeans, Eddington, and a host of others can safely give expression to that which the late C. H. Hinton thought but dared not say, save in a strictly limited esoteric circle.

But perhaps there is still one spot that no radical dare profane—our number concept. Have not shadows their numerical measure, though perhaps not as precisely as we might wish? And must not even four-dimensional space conform to measure and number even more richly than its three-dimensional shadow? Is not number fundamental and eternal?

And then comes Dirac to deprive us of this last standing ground. Here it behooves us to walk warily, lest we darken counsel by words without knowledge, for this aspect of modern theory is both new and difficult of assimilation. Perhaps we may say that Dirac's contribution to modern physical thought is the idea that the really fundamental things of Nature may be absolutely inexpressible by numbers, and that numerical relations begin to appear only when we reach combinations of these fundamentals of a certain degree of complexity.

An illustration? I hesitate; but perhaps a principle familiar to mathematicians may not be too far-fetched.

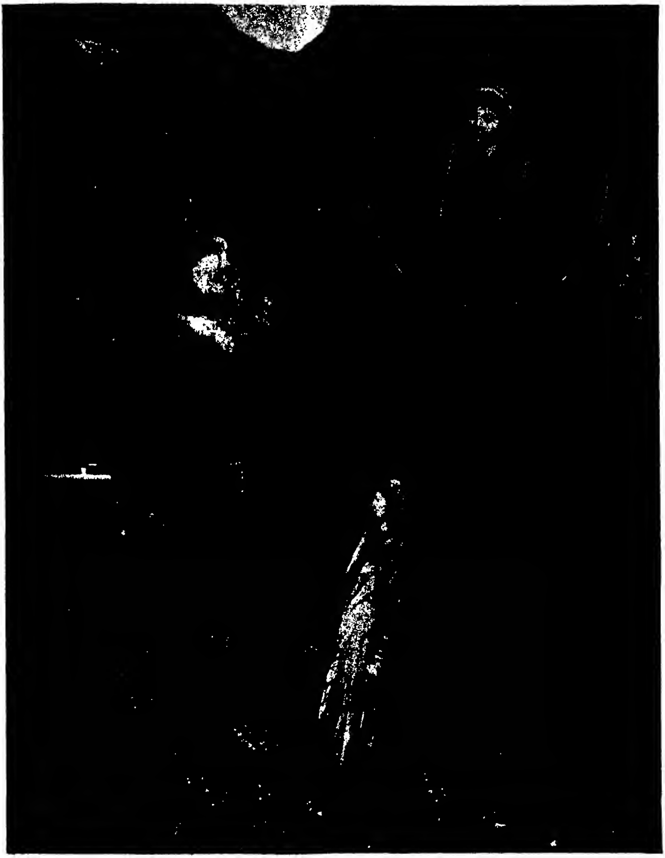
Infinity is a concept that is incapable of numerical expression. Not because it is too big; the difficulty is qualitative, not quantitative. An infinite by its very nature transcends numerical expression, yet the difference of two infinites, or their ratio, may be expressible as an ordinary finite number.

What fitting title may we apply to the realm of physics as we view it today, and how are we to characterize those curious persons who spend their lives working among its insubstantial and ill-defined shadows? Perhaps (with apologies to Aristophanes) the phrase "cloud-cuckoo-land" may fulfil both requirements. And yet such a designation hardly does justice to physicists, for though they have to deal with things apparently far removed from reality they are, as a matter of fact, very practical fellows; for out of this welter and confusion of insubstantiality the physicist is able to extract some very practical and substantial results. We are able to do better work, to cut more closely to Nature's lines, to give better explanations of natural phenomena on the basis of our modern intangible concepts than were the physicists of other days with

Science Service Photo
Schrödinger, Like Heisenberg and Dirac (of Cambridge) he is young

their materialistic ideas. We are not responsible if Nature decides to be what we call unreal. Perhaps it is our definition of reality that is at fault. And ever and anon, to the physicist surrounded by what he still calls insubstantialities, there comes to mind that often quoted glimpse of poetic insight:

"We are such stuff
As dreams are made on, and our
little life
Is rounded with a sleep."



A TINTED STATUE FROM POMPEII'S ASHES

POMPEII continues to give us archeological thrills. One of the notable discoveries of last year is a sculptured portrait of Livia, the wife of Augustus and mother of Tiberius. The statue was found amid volcanic ash from Vesuvius in the villa of Dionysiac mysteries. The villa was named from the wall paintings depicting rites in the cult of Dionysus (Bacchus). When the eruption which overwhelmed Pompeii occurred in 79 A.D., the place of worship was apparently being transformed into a farm. The head is a separate work applied to a torso to which it did not originally belong. The body is probably that of a goddess or priestess. The head is tinted and the original coloring of dark brown eyes, carmine lips, and fair, slightly reddish hair and eyebrows remain. The circular inset shows the body partially excavated.

IT PAYS TO BE A PIONEER

By MILTON WRIGHT

A FEW years ago George C. Hannam was a salaried employee. Today he is president and principal owner of an industrial corporation said to be worth a million dollars. He has his own factory, offices in five cities, and distributors of the product he manufactures in all the principal cities of the country. He even has added a new word to the flooring industry—Hanotile.

George C. Hannam

I knew George Hannam as a boy, I remember that he started to attend two high schools in Brooklyn at about the same time I did, and that he was asked to leave both of them because he wouldn't study. If you had asked anybody in the neighborhood what George Hannam's prospects were for making his mark in the world, you wouldn't have received very flattering predictions.

And yet he has climbed fast and far. There must be, I was thinking when I visited him the other day, some secret of success he has found that I can pry out of him and pass on to other inventors and business men. I determined to ask *him* about it.

"What is it," I asked, "that makes a man a success in industry?"

"There is no formula," he replied. "So far as I know, nothing has ever been found to take the place of common sense and hard work. If, however, you can apply those two factors to an industry that is in its infancy, and, because it supplies a real need, is bound to grow rapidly, then success is assured."

The place in industry that George Hannam occupies is two-fold. He is an authority on acoustic treatment and on asphalt flooring, both of which have developed tremendously in the last decade.

"Just what was it that started you on the course that finally resulted in your being president and principal owner of the American Asphalt Tile Corporation?" I asked.

"I should say," he answered, "that it was the realization that most men in executive positions seemed to be college graduates. I was a stenographer—and not a particularly good stenographer at that—and as I looked at the men above me, it dawned upon me that what I needed was a specialized education. I quit my job—it was the sixth I had held in a short time—and studied day and night to enter college. I entered Cornell in 1909. I earned part of my way, selling aluminum cooking utensils and magazine subscriptions in the summer time and waiting on tables, tending furnaces, and even playing the piano in a club dining room during the school terms."

He laughed when he said this; he knows I have heard him play the piano.

"When it came time to graduate I listened to the blandishments of a representative of an iron foundry in Ohio, one of those men who visit technical colleges in June to induce young men to enter their particular establishments. I took a job in the foundry, but quit it three days later. I could see no future in it.

"It seemed to me that the money to be made in business lies in the selling end. I came to New York and applied to the H. W. Johns-Manville Company for a job.

"We have nothing for you," said the employment manager. "If you only knew stenography we could find a place for you."

"That's fine," I answered. "I do know stenography."

There was nothing for him to do but give me a job. I was assigned to the acoustics department. Three weeks later they found an opportunity to send me out on some installation work. I was on my way.

"Pretty soon I began to bring in new jobs to be done. I was a sort of volunteer salesman, so in about five or six months I was made a regular salesman. Increase in the acoustical treatment of offices, schools, churches, and other buildings was rapid, and after a time I was made a sort of supervisor over the acoustical work of the Boston and Montreal offices.

"IN Boston I consulted constantly with Professor Wallace Clement Sabine, Dean of the Graduate Schools at Harvard. He was the greatest authority of acoustics the world ever saw, and by the time I was transferred to the Cleveland district, a little less than a year later, I had acquired a foundation in this specialized subject that was invaluable. In less than another year I was made manager of the New York acoustical department."

"Now just what was this acoustical work?" I felt called upon to ask at this point.

"It's doctoring up rooms to quiet them," he answered. "You take a large office with 50 typewriters going at once, and nobody can hear himself think. Or take a poorly designed auditorium; echoes and reverberations get so bad that the remarks of the speaker are all jumbled up by the time they reach the audience."

Spark photographs of sound waves showing, *left*, a sound wave being reflected (an echo) from a smooth hard surface, and *right*, sound waves being absorbed by a surface that has been treated by the method described, to prevent reverberation

"And how do you correct it?"

"You apply a layer of felt to the walls or ceiling. Then over that, separated from it by an air space, you stretch a thin cloth. The sound waves pass through the cloth and air space and are absorbed by the felt, instead of reflected back in the form of echoes by the hard walls."

"But isn't this cloth rather unsightly?"

"It used to be. That provided me with the opportunity for my first invention—an acoustic paint. Ordinary paint on the cloth would reflect back the sounds—especially high pitched sounds like those of a typewriter—almost as much as would the bare walls. If you painted over the acoustic treatment cloth there was little improvement over the condition before the treatment was applied. Men had been seeking for years for a paint that could be used, but, for some reason, none of them had found it.

"IT could be done, I was convinced, and I made up my mind to do it or get out of acoustical work. For months I devoted all my spare time to gathering information about paint from all sorts of places. Then, for three months, I concentrated on the subject with the co-operation of a paint company. At last I had it."

"Did you patent the formula?"

"No; I didn't know as much about patents then as I do now. I was interested in selling and applying acoustic treatment and a patent never occurred to me.

"Shortly before this, Junius H. Stone, who had been manager of the cork insulation department of the corporation, had left to establish his own company, and he asked me to go with him to form an acoustical division of the business. I now found myself in keen competition with my former employer. Every point of advantage I could gain was worth striving for. Remembering what a stimulus had been given to acoustic jobs by the acoustic paint, I believed that history could repeat itself, so I set to work on a new and better acoustic paint. I got it.

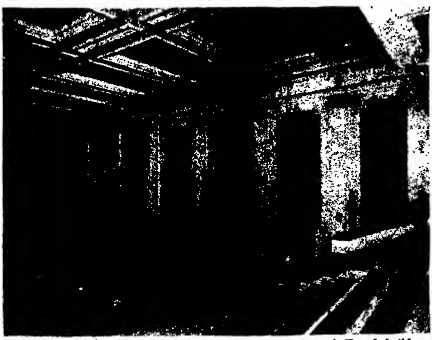
"Meantime, Mr. Stone, whom I consider one of the foremost industrial scientists of the country, had developed an asphalt tile flooring. He also, by the way, was the originator of cork tile flooring. I was placed in charge of the flooring department in addition to the acoustical. This new type of flooring was something large buildings like schools, hospitals, offices, churches, and gymnasiums were looking for, to replace mastic flooring.

"It was left to me to go ahead with this pioneer type of flooring, for Stone's business had so developed that he decided to devote all his time to cork insulation, in which he saw a great future. I formed a separate corporation, taking over the acoustic and flooring ends of the business.

Mining gilsonite, the asphalt from Utah used in making an improved floor tile

"There was a real need for such a flooring and our business developed rapidly. Competitors began to appear and inevitable price-cutting followed. Any lead that we might have had due to being the pioneers was in danger. There was only one thing to do, as we saw it, and that was to keep on pioneering.

"Constantly we kept testing and experimenting, carrying on research work, until we had evolved a better asphalt tile, using gilsonite, an asphalt common in Utah. We took out a patent on it, but our competitors were right on our heels. We kept on working out new ideas, and at last got a tile that was as near the ideal as it was possible to make it, from the standpoints of wear, comfort, freedom from denting, and the like. We took out another patent.



Both the ceiling and side walls of the auditorium of the Masonic Temple building in Birmingham, Alabama, being treated to improve acoustics and reduce echo

"Every improvement was accompanied by an increase in business. Today, I should say, we have laid more asphalt tile than anybody else in the world and our product is recognized as the standard. For the particular type of flooring that we do the future is remarkably promising; the majority of the flooring in all large buildings—schools, offices, institutions of all kinds—will be asphalt tile; more and more it will be used in the home. And somebody—either our corporation or somebody doing the type of work that we are doing—is going to have a lot of work to do.

"I think I'll revise that statement I made to you a little while ago about the secret of success in industry. One way to gain success, I should say, is to be a pioneer. Get in at the start of some industry—something that fills a modern need—and then keep constantly perfecting your product or your service; keep a little bit ahead of the procession in the matter of ideas, if that is possible. Do that and you don't need to worry about success."

NATURAL GASOLINE FROM OIL WELLS*

By G. ROSS ROBERTSON
r, University of California at Los Angeles

Outline map of California showing approximate loca-

ABOUT seven years ago, certain renowned but pessimistic geologists predicted a dire shortage of petroleum in the United States within 10 years. They still have three years' grace in which to fulfil expectations. There are, on the other hand, three substantial elements of doubt attached to that prediction. These are, respectively, Texas, Oklahoma, and California. Just at present the greatest of these seems to be California. At least may it be said that the Kettleman Hills were not on the oil map in 1923.

The false prophets have done us no harm. They probably frightened us into a speedy development of Ethyl gasoline, cracked petroleum, and various other commendable economies. One of these economies is that of stripping volatile gasoline from wet natural gas, a process that is carried out on a large scale in the Kettleman Hills field in California.

The limited demand for kerosene in recent years has made it desirable to throw an increased fraction of heavier hydrocarbons into motor fuel. Such heavy distillates need enrichment with a special supply of volatile material. Thus has arisen the modern natural-gasoline absorption plant which salvages the desired fuel.

There was a time when an absorption plant took care of 40 or 50 wells in its neighborhood but two Kettleman wells are sufficient to serve the plant described herewith. When one of these is drilled to the full projected depth, it is quite possible that it may take over the whole duty alone. The present production by this plant of over 80,000 gallons of high-grade absorption gasoline daily means that more than 500,000 gallons of motor fuel may be marketed after blending with straight distilled gasoline.

The Kettleman field is a wide stretch of rolling hills far out in the midst of the barren, sun-baked valley of central California, a few miles south of Coalinga. Literally hundreds of square miles of bare clay loam surround these hills. Any one of these square miles is a perfectly good airport, and oil magnates with private planes visit their property without much concern as to their skill in selecting a landing place. Near the western edge of the hills, the shack town of Avenal has suddenly sprung out of nothing. The town is not substantial, but it is clean. This is a new idea in oil towns, and there's a reason.

After experiences in old-fashioned oil fields, the visitor expects to find a succession of grimy derricks, ill-smelling black oil sumps, and an atmosphere soaked with crude oil mist. Not so. Instead of muck and mire, one finds at a Kettleman well a spick-and-span outfit, resplendent in aluminum paint, with gas valves done in vermillion and oil valves in a beautiful apple green. In these arid hills there is little rusting and no grime.

The well doesn't deliver "crude oil" in the ordinary sense. Rather it pours out a mammoth stream of native, ready-made raw gasoline, accompanied by vast quantities of high-pressure gas. By some remarkable provision of nature, Kettleman "oil" is composed almost entirely of volatile hydrocarbons. In some cases the liquid is almost water-white as delivered from the casing-head. At other wells the product, while as free-running as commercial gasoline, is colored in varying shades of brown.

ONE enterprising Kettleman operator subjects the oil to a slight purification, not involving distillation, and markets it directly as motor fuel. The trade seems to be satisfied with its performance, and likes the cut price.

The visitor to Kettleman is invited to hold his hand under the discharge valve on the oil trap at the well. A light liquid pours over his hand. One or two shakes of the hand in the air and the liquid has evaporated, leaving only a slight smell which suggests that nature did not refine her product quite well

Clyde Sunderland, Oakland, California

By some process known to herself alone, nature has cracked the crudes in the earth beneath Kettleman Hills field so that the wells produce gasoline and great volumes of gas

enough to pass a city motor-fuel ordinance.

The following may be taken as a normal or composite picture of a mature, full-grown Kettleman oil well:

It is about 8000 feet deep. It probably cost about 200,000 dollars to drill or, if there was bad luck in the last thousand feet, add a couple of hundred thousand more. It pours out daily, in a foaming and roaring stream, 5000 barrels of volatile petroleum, marketable at double the price of common crude oil. Without further treatment this "oil" is already slightly superior to some of the "bootleg" gasoline sold by minor concerns outside the cities. If the well has reached a particularly deep oil sand, there may be a small but important fraction of lubricating oil in the crude product.

OUT of the foaming stream come 100 million cubic feet of wet natural gas daily, at a pressure of 1000 pounds per square inch. This gas goes through an absorption plant, and gives up about 90,000 gallons of high-test gasoline. The remainder, mostly methane, is thrown away.

Rising spotless and shining in the brilliant California sunshine, the new absorption plant is a beautiful sight by contrast with the drab and barren clay hills round about. Only the offices, laboratory, and a few pieces of minor equipment are housed. Rains come seldom and sleet never. Everything takes the fresh air—the more air the better, should natural gas choose to leak out at some unsuspected point.

At the present writing the two connected wells nearby deliver daily 92 million cubic feet of wet gas through a 14-inch main at a regulated pressure of 450 pounds. Quite naturally the oil which has just been separated from its equilibrium contact with the high-pressure gas contains a large proportion of the much-desired intermediate hydrocarbons, such as the pentanes and hexanes. Accordingly a second and third quota of gas are taken from the oil, each at reduced pressure. The final withdrawal of gas is made at a slight vacuum, leaving the liquid product relatively stable in tank storage. The whole supply of wet gas is sent to the absorbers.

Resplendent in aluminum paint: Stabilizer and fractionating units of the absorption installation

The plant consists of two absorption units, each having a capacity of 50 million cubic feet of gas a day; a stabilizer taking care of both units; a boiler plant with four operating units and one stand by; a cooling tower serving several devices; gasoline storage tanks, centrifugal and piston pumps, compressors, and so forth. Briefly summarized, it operates to extract most of the hydrocarbon content of the gas from propane up the series; then to reject by fractionation some n-butane and everything below butane from the crude distillate produced.

One of the two fractionating units for recovering the raw gasoline from the absorption oil

A chemical concept of the absorption problem may be gained from a typical analysis of Kettleman wet gas:

	Percent by volume	Gallons liquid per M cu. ft. gas
Methane	83.26	
Ethane	8.34	
Propane	4.70	
Isobutane	1.06	0.35
n-butane	1.54	0.49
Pentanes-plus	1.10	0.47

From the absorption standpoint methane and ethane are worthless. They dissolve slightly in the absorber oil at high pressure, but soon escape the apparatus. Propane (boiling point —45 degrees Centigrade) is equally worthless, since it is too volatile to remain in appreciable quantity in a motor fuel as commonly stored. It is, however, sufficiently condensable to make trouble farther on in the plant process. It is accordingly eliminated completely only after careful fractionation. The isobutane is almost worthless, and goes largely with the propane. The n-butane is a normal component of absorption gasoline, but there is nearly 50 percent more of this hydrocarbon in Kettleman gas than the final product can stand. There must accordingly be a substantial rejection of butane.

"Pentanes-plus," meaning all higher hydrocarbons, are the most desired, and the plant is designed to give practically complete recovery of such material. Undoubtedly there is a large amount of hexanes and heptanes, with dwindling percentages of a few higher members of the series and possibly cyclo compounds of unknown quantity. Practically no other gas is present.

THE wet gas, at 450 pounds pressure, enters the absorbers, where the soluble components dissolve rapidly in the oil which partially fills the towers. This oil is a relatively non-volatile refined petroleum of the "mineral seal" type, somewhat heavier than kerosene. In it are combined a high boiling range with minimum molecular weight. In this way a high gas solubility is attained, and at the same time a low loss of oil in distillation of the gasoline from the absorbed mixture, or "fat oil." About 675,000 gallons of oil circulate normally through the plant cycle.

All the desired hydrocarbons, and many more, are now absorbed in the foaming, dripping mass of oil in the absorber columns. The "dry gas" escaping absorption is promptly diverted.

General view of Los Nietos Plant, showing nine absorber units to the left, water tower and boiler plant to the rear, and gasoline storage tanks in foreground

The fuel value of this gas is practically identical with the gas fuel which is now standard in domestic service at Los Angeles. Absorption reduces the volume of the gas only about 8 percent, so that more than 80 million cubic feet must now be disposed of.

A portion of the dry gas is put to novel use in driving turbines which serve the necessary pumps of various kinds. In the face of dubious comments of turbine engineers, the builders of this plant have succeeded in driving standard steam turbines on high-pressure gas with even less damage to interior parts than occurs with steam itself. For this purpose the gas is reduced to 185 pounds pressure, heated with exhaust steam to forestall the formation of ice in the turbines, and then put to work.

THE existence of casing-head pressures up to 1100 pounds has suggested the use of gas in electric power plants, in which the energy would be derived merely from the expansion of the gas, after which the expanded but undamaged gas would be sold as fuel. Unfortunately the gas occurs at a distance of more than 200 miles from the nearest industrial center, and a large part of the 1100 pounds pressure would be needed to boost the fuel to its destination without allowance for electric power production. Not all has been said on this subject, however.

A small amount of the dry gas is reduced to very low pressure and used as fuel under the boilers. The remainder, which is nearly the whole supply, is led out a safe distance up a hill and blown off to the atmosphere as waste.

The "fat oil" from the absorbers, saturated with all the hydrocarbons, passes through tanks, where a slight relief of pressure vents a large part of the methane, ethane, and propane. It then passes to the pressure heat exchanger, an outstanding feature of the plant. Here by application of the counter-current principle, piped streams of "fat oil" pass a distance of about 60 feet counter to the returning "lean oil" from which the gasoline has been stripped. The contact is of course thermal, not an actual liquid contact. In this way the lean oil is partially cooled, with great saving in precious water. The "fat oil" in turn becomes heated, thus saving much steam.

The fat oil is still further heated in the second or gravity heat exchanger, and thence passes to the pre-heater, where it receives a temperature boost with the aid of boiler steam. The oil then passes to the fractionator, where it is subjected to steam distillation.

The vapors emerging from the fractionator pass, in turn, through a primary water-cooled condenser, a primary dehydrator, and then a secondary condenser and dehydrator. Automatic separatory devices permit a continuous flow of raw gasoline and re-condensed water. The dehydrators are merely tanks with weirs, and play the rôle of separatory funnel.

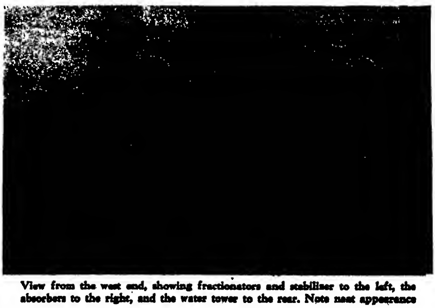
The hot oil—now lean—returns through the heat exchanger, yields a part of its heat energy, and is ready to do business once more at the absorber.

The hot, stabilized gasoline is now cooled and sent to short time storage in local tanks. It is then pumped at high pressure for a distance of 90 miles to the San Luis Obispo coast region, where it is received by a major company for blending purposes.

OF [illegible] experienced oil operator dares predict the life of his field, but in the case of Kettleman Hills it is apparent that a supply vastly beyond conception has barely been tapped. The major supply is deep. Levels from 7000 to 8000 feet are furnishing the present flow. Recent drilling to extreme depths is encouraging in the production of oil containing more lubricants.

One may speculate freely over the existence of lower hydrocarbons rather than heavy oil. Has the original carbonaceous matter all been cracked into material of low molecular weight? Or is the present production merely nature's first fraction in a cosmic distillation of stupendous magnitude? And may we find the really great supply of heavier oil by drilling yet deeper?

Fortunately Kettleman Hills was not subdivided into town lots, as was Signal Hill. As a result there will be no forest of useless derricks erected by a horde of small operators hustling to outdo each other. There are no free lunches, bus rides, or curb markets crying "oil units." Furthermore, drilling at 7000 and 8000 feet is not an operation for small private finance. As a result it is hoped that there will be a controlled and economical exploitation of the field.

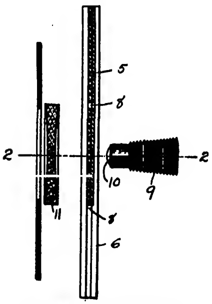


View from the west end, showing fractionators and stabilizer to the left, the absorbers to the right, and the water tower to the rear. Note neat appearance

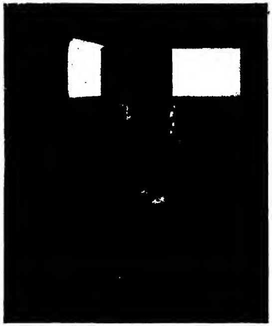
POSE YOURSELF FOR YOUR PORTRAIT

IT is a far cry from the iron head clamp and "Watch the hirdie" of the late 19th and early 20th Century photographer to the equipment and tact of the present-day portrait specialist, but the psychological effect on the sitter is still much the same. No matter how the average person may try to compose himself, no matter how reassuring the admonitions of the photographer to "just relax, and look natural," the ordeal of having a portrait taken is one from which that average person would like to escape.

A new portrait cahinet, the invention of Luther G. Simjian, director of the photographic department of the Yale School of Medicine, has been perfected in an effort to remove the mental hazards of portrait photography, and make it possible to produce high-quality portraits in natural poses with the least wear and tear on the subject. This device is no quarter-in-the-slot, ten-pictures-in-a-strip amusement resort affair, but is designed as an adjunct to the equipment of the professional photographer. It handles five by seven inch film and produces negatives of such quality that enlargements can be made from them to any required size.



The camera, 9, is focused on the subject through the large lens, 11, but the mirror, 5, is interposed. When the sitter presses the final button the mirror is drawn rapidly down by hydraulic means and the exposure is made through the slot 8



Through a system of mirrors, the sitter sees the same view before her that we see in the center

THE subject enters the booth in which stands the cabinet, is instructed as to what to do, and is left alone. She can take as much time as she desires in selecting her pose or poses. Comfortably seated, she looks straight ahead and sees a reduced image of herself in a mirror in the center of the cabinet. This image is just the same size as will be the finished film. Looking to one side or the other she sees additional openings in the cabinet, under each of which is a button. Pushing one of these, she sees an image of herself in another mirror, but this image is the *same as that which will be seen by the camera located behind the center mirror.* There being five such openings, she can study herself from all angles and proceed to take from one to five different portraits of herself. All she has to do after selecting the desired pose is to press a second button which she holds in her hand.

Essentially, the PhotoReflex operates as follows: The center mirror, in front of the camera, is arranged to slide vertically when operated by a hydraulic arrangement actuated when the second button is pressed. In front of this mirror is a large condensing lens, which serves to reduce the image seen to the proper size, and also to give greater depth and definition to the negative. The center mirror is slotted horizontally so that when it slides down the exposure is made through this slot. By a mechanical linkage the center and side mirrors are turned so as to give the effect described, when the first button is pushed. At no time is the subject "camera conscious," nor is she aware of the exact instant at which the exposure is made. The exposed film is developed and fixed by a professional photographer, any necessary retouching is done on the film, and prints or enlargements are made in the usual manner by expert technicians.

Five views taken by the photographic method described here. The original prints from which these reductions were made

various mirrors are of the same size,

INTO A HIDDEN WORLD

By M. C. SWINGLE

ONE of the n . . . . of all amateur scientific hobbies is the observation of the microscopic life which may be found in almost endless variety and profusion in ditches and even puddles, the world over. Now that mass production methods have made available suitable microscopes, magnifying from 50 to 200 diameters, at remarkably low cost—ten or twenty dollars—the hobby is relatively inexpensive. Several splendid treatises on this hobby are obtainable. The accompanying article gives just a peep into the microscopic pond-life world.—*The Editor.*

FOR the student and lover of natural history there is no more fascinating field of study than the microscopic plants and animals in a drop of stagnant water. To those who would give vent to a cherished desire to explore, to have adventure, or merely to admire things that are beautiful, this little world offers itself for their consideration.

The scientist, the nature lover, and the philosopher, each can find material for his fondest dreams. Thanks to the microscope we are permitted to gaze upon this world of rare beauty, but with all our power and great wisdom we are not able to enter and become a part of it. But, just as astronomy is none the less interesting because we cannot visit the places *we see* through the telescope, likewise, the study of a drop of water makes strong appeal to our curiosity. Through the large reflecting telescopes of modern science we watch the planets and stars; imagination leaps from the soul of little man and travels in the solitude of the heavens. From this splendor we turn to the small ocular of our compound microscope, and visually, at least, we enter into a fairyland of busy creatures, hurrying in every direction, bumping into one another, and again scurrying on their way. Gay colored, microscopic plants come floating by. Their structure rivals the patterns of snowflakes. Thousands of busy creatures are seen living the life that is given to them to live.

***Figure 1:* Two specimens of *Paramoecium*, the one at bottom dividing. The object at top is a bubble**

The only equipment necessary for the journey into this strange world is a compound microscope, a few glass slides, a pipette, a small bottle, and a pond of stagnant water. A small bottle of water collected from the edge of the pond, among the dead and rotting leaves and grass, will contain countless numbers and generally a wide variety of these tiny living individuals.

As we walk into our laboratory holding millions of living creatures in the palm of one hand, we cannot help being impressed with the relativity of life. Where a moment before we were so insignificant among the planets and stars in space, now we are a mammoth creature carrying a strange world in our hands in which are millions of living individuals.

A single drop of water is placed upon the glass slide on our microscope and we slowly open the window of this strange realm which we may watch but cannot enter. As we peer through the little round window, a large, slipper-shaped individual comes floating by, poking its nose into everything that comes in its path. The *Paramoecium*, as this inquisitive being is called, is an animal of the very simplest construction (Figure 1). It has no bones, nor any special organs, but is a single cell carrying on all the processes necessary to maintain life. The surface of its body is covered with fine hairs which may be moved in an orderly manner so as to produce locomotion and thus facilitate the acquisition of food. This food is composed of smaller animals and plants which are swimming freely in the water.

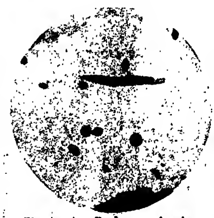


***Figure 3:* *Euglena* swimming through a cluster of microscopic plants. Its propelling appendage does not show in the photograph**

The *Paramoecium* reproduces by simply constricting through the central region and dividing into two individuals, each of which swims away as a new to grow to normal dimensions. This division and regrowth may take place from two to five times in 24 hours, depending upon the temperature and food available. Barring any catastrophe, these simple creatures realize the human aspiration to eternal life. Theoretically they do not die, but merely divide and each half continues living.

***Figure 2:* *Vorticella*. The one on the right is contracted, while the tube of the other one is extended**

Before our aided eye passes a great number of little creatures similar in habit and general construction to *Paramoecium* but slightly different in appearance. Massive grains of sand glittering like diamonds are scattered about the scene. Here and there is a large mass of decaying leaf or other fragment of plant. On close examination we can see a strange animal resembling a bell, fastened to a mass of debris by a long, spring-like stalk. This strange creature is a *Vorticella* and has many

peculiar adaptations (Figure 2). Its mouth is wide and is surrounded by a row of strong hairs which are moved in such a way as to produce a constant current of water down through the mouth and gullet. This current of water sweeps large numbers of small animals and plants into the stomach of the *Vorticella*, thus supplying the food. As we watch the strange creature a violent current is set up in the water and all small plants, animals, and debris are swept into the mouth. The current is so strong that a large mass of debris is drawn toward the creature from a distance, finally striking the delicate animal. This causes it to contract its long, spring-like anchor tube and the animal is drawn quickly away from the danger zone. On examining the little creature we find that it has so contracted itself that it resembles a sphere, having closed its mouth and drawn in the row of surrounding hairs. After a few seconds the anchor tube slowly relaxes and the animal is pushed out to its original position and form.

FROM behind a large grain of sand comes a beautiful, green individual which has one peculiarity that is almost

Figure 4: Phacus, a near relative of Euglena, is always ready to go

unique. Human observers, with their customary desire to name everything, have long been in doubt as to whether this strange individual is a plant-like animal or an animal-like plant. They have named it *Euglena* (Figure 3), but its position on the family tree is still somewhat indefinite. Its beautiful green color rivals that of many of the strange plants floating about but this individual does not float about aimlessly as they do. Its body is continually turning on its long axis in a manner similar to that of an auger. In front is a long, whip-like appendage which is moved in a regular manner in the water to aid in locomotion. In direct contrast to the *Paramoecium*, the *Euglena* seems always to be going somewhere and is doing so in a straight line without delays. Toward the anterior end of the body is a bright red "eye" by which light is distinguished from darkness. The *Euglena* has a relative called *Phacus* which is very similar in general structure, being somewhat shorter and deeper (Figure 4). These two yellow-green individuals with their red eyes and long, whip-like appendages present a striking sight as

Figure 5: One of the diatoms and, below, a fragment of Spirogyra

they wend their way in and out among the grains of sand.

We have met the *Paramoecium* with its fickle personality, *Vorticella* with its destructive, bullying personality, cringing and cowering when struck by something its size, *Euglena* with its business-like determination to go somewhere, and now we come face to face with the most treacherous personality of all. Slowly and stealthily it approaches like a great octopus, in its precaution barely moving along. We recognize the *Amoeba*, the demon of this water world. Like a mass of jelly it quietly flows along and engulfs the unsuspecting microscopic animals and plants in its path. From its jelly-like tentacles there is no escape. Those who would survive must be continually on the watch for the stealthily crawling *Amoeba.*

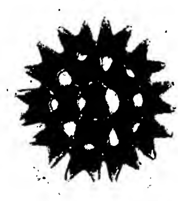


Figure 6: Pediastrum, a beautiful plant composed of sixteen sections arranged with geometric precision

From these hard realities of life we turn our attention to the beautiful plants that float about in fairyland gardens. Vast numbers of beautiful, yellow-green plants cover the entire field. The great majority are simple plants composed of a single cell and commonly called algae. Some are round, others are square, oblong, diamond-shaped, or have very complex forms. The free-living plants are often of very beautiful designs. Across our field of vision floats a large, cigar-shaped diatom (Figure 5, upper left hand corner) of a beautiful green color with extremely delicate striations or ribs running from the center toward each side. If we approach closer to this floral spectacle by swinging our microscope into higher magnifications, we are amazed by the intricate design of the surface and the exactness of its form. A greater hand than ours must have been at work!

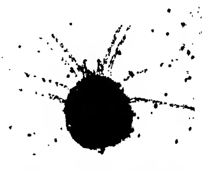


Figure 7: A water mite, the "giant" which broke up the performance

Swinging our vision again into lower magnifications, we are surprised at the strange plant that has floated into view (Figure 5, below). Several cells can be seen in this plant, a beautiful green spiral braid enclosed in the center of each cell. This plant belongs to the genus *Spirogyra*, which includes a large number of species. This genus includes long, thread- or filament-like plants composed of a number of cylindrical cells attached end to end. The cells are in no way dependent upon each other but carry on their own life processes individually. The species that we see before us is one of the larger ones.

AS we gaze in admiration at the colors and amazing forms of these beautiful plants, a great commotion is set up in the water nearby. Little animals scurry for the protection of a clump of debris. Plants are forced to and fro by the "great" currents set up in the water. Grains of sand come rolling across the field like boulders in a mighty whirlpool. *Vorticella* is torn from its stalk and washed away with all the other strange creatures that we have seen. Giant, spider-like legs have come racing into our view carrying a mammoth body which blots out the entire scene beyond. A great water mite (Figure 7) has obstreperously entered this settlement of peaceful residents and beautiful plants, destroying the entire scene and scattering the inhabitants of our microscopic world.

ASQUITH AND KITCHENER

By CAPTAIN W. D. PULESTON*

United States Navy

(Concluded from August)

AMONG other precautionary measures taken during the period of uncertainty, Asquith detained in England Kitchener who was on leave from Egypt. On August 5, with considerable misgivings, he installed Kitchener at the War Office for the duration of the emergency. Asquith and Kitchener agreed that, in taking this civil post, Kitchener was to have no politics and he would return to Egypt as soon as the war ended.

When these two Englishmen, Asquith and Kitchener, each pre-eminent in his own sphere, took their posts for the impending struggle, the whole British Empire was content to leave the conduct of the war in their experienced and capable hands. Asquith, though primarily concerned throughout his career with domestic matters, had kept close touch with foreign affairs and the relative condition of the European armies and navies; he knew the usefulness of the Committee of Imperial Defense, was well acquainted with the leading Army and Naval officers, and had supported Haldane in his efforts to provide an effective expeditionary force and Churchill in building up the Navy.

KITCHENER with an unbroken record of successes, administrative, diplomatic, and military, also inspired the confidence of his Allies; his reputation was international. Even Kitchener's personal appearance was helpful, for he looked the part the British people expected him to take in their war drama; his massive stature, his martial carriage and his grim, almost forbidding countenance united to give anxious observers the feeling that here was the strong, silent man upon whom they could depend. In the early war days crowds stood around to watch him enter and leave his office, but as he habitually ignored their presence, they quickly ceased to gather.

Kitchener's first official statement, that the war would probably continue three years, although at variance with all other expert opinion, was accepted at once, and the British people nobly responded to his call for a maximum military effort, although a narrow interpretation of their duty to the Entente might have limited their liability to maintaining the Expeditionary Force and controlling the seas. The almost Puritanical tracts that he had placed in the soldiers' knapsacks pleased the majority of his countrymen; and, although these tracts furnished some merriment to his Gallic allies at this evidence of British prudery, his attitude fitted into the crusading spirit with which England entered the war.

He was less fortunate in other decisions; he knew little of General Staff methods; he did not realize the complexity of modern mobilization or the intricacies of troop movements; consequently he did not hesitate to change the carefully prepared railway schedules to the detriment of the embarkation plan. He also delayed the dispatch of two divisions of the Expeditionary Force to France. He had a distrust of the Territorial System which Lord Haldane had created, so he immediately began creating a third army—the New Army, popularly called Kitchener's Army. Thus he committed Great Britain: first, to maintaining the Regular Army, most of which was in the Expeditionary Force; second, to bringing the Territorial Army to war strength; and third, to creating and maintaining the New Army. The attendant difficulties would have appalled a smaller man, but Kitchener with well-founded confidence in the British character, serenely commenced his task, fixed 70 divisions, approximately a million and a half men, as a tentative goal, with the firm resolve that though England entered the lists with the smallest army of any of the Great Powers, the end of the war, which he thought would come in 1917, would find her with the largest army in Europe and able to dictate the peace.

READERS who desire to inform themselves more thoroughly on the activities of the two great Englishmen treated in this and the foregoing article will find much of interest in the available books listed below.

Life of Lord Kitchener,
By Sir George Arthur
Speeches,
By Earl of Oxford and Asquith
Twenty-five Years,
By Edward Grey
Before the War,
By Viscount Haldane
The Crisis—Vol. 1,
By Winston Churchill
Recollections,
By Viscount Morley

This list was compiled by Captain Puleston, and other titles are available for those who desire them. —*The Editor.*

Kitchener also predicted correctly the line of advance of the German Army through Belgium into France and pointed out that it would thus outflank the British Army about to advance to Mons and probably force its retreat. When this retirement took place, Kitchener had to intervene to prevent Lord French from separating the Expeditionary Force from Joffre's Army and falling back to the Channel ports. He next reinforced French's Army to the limit, but very wisely held in England a bare military nucleus with which to create the New Army. He had to resist the importunities of General French and the whole staff of the Expeditionary Force, who insisted that they could win the war by Christmas if only given the men and officers then in England. Thus in his major decisions early in the war, Kitchener abundantly justified his countrymen's confidence; his one large decision open to question was his abandoning the Territorial System for his New Army. Competent judges believe the existing system would have yielded quicker results. Nor did he at this time anticipate the enormous amount of munitions necessary for modern armies.

AS the war continued into 1915 with the balance inclining to the Germans, Kitchener became puzzled; all estimates of expenditures of munitions based on previous wars proved inadequate; the factories of England and the United States were unable to equip and munition his new divisions; the expenditure of men and material on the Western Front had to be made good, while Lloyd George and Winston Churchill began to advocate an offensive in the Near East.

Kitchener then confronted his first important strategical decision: should he commit the British Armies being raised to a major campaign in the Balkans and Turkey, or deliver them to General French to employ against the Germans then established in France and Belgium? The Central Powers were able to transfer men from the Eastern and Western Fronts more readily than the Allies, so Kitchener was to a certain degree obliged to conform to German movements; except for this necessity, thanks to the Allied command of the sea, Kitchener could employ his New Army in Flanders and the Near East.

(Please turn to page 209)

*The opinions and facts in this article are the personal ones of the writer. They are not to be construed as official or reflecting the views of the Navy or the Naval Department.

"FORM" LETTERS WITH A PERSONAL TOUCH

HAVING shown recently a typewriter which is operated by electricity we now illustrate the Auto-typist which can write approximately 117 words a minute. With it, form letters can be given the personal touch so desirable in direct-mail advertising in that the name and address at the head, as well as personal remarks and so on in the body of the letter can be inserted manually in the same type, so as to be indistinguishable from the rest. The system comprises two machines, one of which is a perforator which has a standard keyboard. The operator punches a record roll like that of a player piano. This record is introduced in a space back of any typewriter of standard make attached to the specially built typewriter desk. The paper record passes over a tracker bar and when a perforation is over any of the apertures in the tracker bar the corresponding key in the typewriter is depressed through the medium of small individual bellows (45 in all) as shown to the front and below the typewriter. Upper case letters are struck after a larger bellows depresses the shift key. There is a tube connection between each bellows and the tracker bar. The principle and even the material is exactly the same as is used in player pianos. Another larger bellows shifts the carriage automatically when the end of the line is reached.

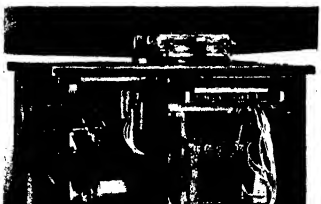
One girl does the work of 12 typists in writing personalized letters. This typist operates four pneumatic typewriters with perforated rolls

Perforator is driven from the pump-bellows. It has a standard keyboard and punches the record

The power plant consists of a 1/6 horsepower, 1140 R. P. M., electric motor which drives a four-cylinder pump bellows. This bellows develops a suction of about 10 pounds per square inch, sufficient to give the proper "touch" to the typewriter keys. The suction is conveyed through a governor which regulates the suction used to operate the typewriter. By increasing or decreasing the amount of suction a heavier or lighter stroke can be given to the key so that impressions can be matched with that of the manually operated keys. There is a screw valve in each tube so that the keys can be adjusted independently of each other. A simple wire hanger serves to depress the key. When the record finishes typing the letter it automatically rewinds.

The greatest economy is effected when a battery of four machines is used. One operator can take care of them, typing in the salutation or putting in individual names or special wording in the body of the letter.

The typewriter is driven at high speed by pneumatic mechanism. Bellows actuate type bars, shift key, and carriage



Rear view: *left;* power plant driving a four-cylinder pump. *Right;* an air motor for operating the record paper

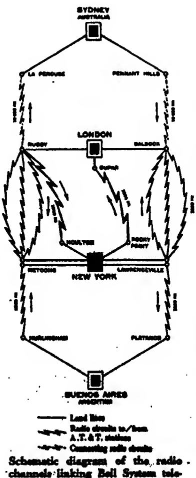
Upon superficial inspection, the uninitiated might say that these are ordinary central office boards, but there is a world of difference. These constitute the foreign switchboard in the A. T. & T. Company's office in New York

WORLD AFFAIRS AND THE TELEPHONE

WITH the inauguration of transatlantic telephone service in January 1927, sanguine hopes for its good effect on international relationships were expressed by many who believed that the warmth of the spoken word would help to bring about a feeling of international friendship and would create better understanding. Whether this has followed after four years of the service is a moot question, but there has been at least one instance where it has probably helped to speed an important international agreement.

During the negotiations relative to the war debt moratorium plan proposed by President Hoover, the success of the whole plan seemed to hinge upon a perfect understanding of the various phases of the question. Speed also seemed to be a prerequisite to its success. Therefore, rather than depend upon an endless stream of wordy cablegrams, American diplomats in Europe used the telephone to discuss with the President certain angles of the plan which needed untangling as the discussions, particularly with France, became more and more involved. European diplomats were amazed at this entirely new form of diplomatic action, and an accord was speedily reached.

Prior to 1927, it was possible for a Bell System subscriber to lift his telephone receiver from its hook and call any one of 18,000,000 subscribers in this country and Canada. On January of that year, the opening of the first transatlantic voice channel by linkage of the telephone and radio made it possible for any subscriber in the metropolitan or suburban area of New York to connect with any telephone in a like area of London, England. The service was rapidly extended during the year to cover all of Great Britain and, on this side, the entire Bell System, Cuba, and eastern Canadian cities.



Schematic diagram of the radio channels linking Bell System telephones with those of the world

AT the present time a total of 32,500,000 telephones out of the 35,750,000 in the world are interconnected for service, the Bell System in this country being connected with all countries in the world having more than 100,000 telephones, with the exception of the following:

Japan	940,000 telephones
Russia	370,000
Brazil	170,000
New Zealand	165,000
China	155,000
Union of South Africa	110,000

Arrangements are now being made for connecting us with Japan and Brazil. Connections with New Zealand will be made by the Australian telephone system, when warranted by the demand; connections with China will necessarily await a more stable Chinese govern-

ment; while those with the Union of South Africa will doubtless be made by the British from England. Russia has no telephone system.

A voice from any telephone in North America to one in a country across the ocean follows a devious path. First it is brought by wire to the overseas control switchboard in New York City where it is partially prepared for its journey. Still on wires, it travels to one of the American transmitting stations where the voice currents are amplified many million times and then sent out in the form of radio waves. If the call is for Europe or Australia these waves, weakened by their long jump, are picked up at a receiving station in England, amplified to proper strength again, and the voice currents put back on wires and sent to the London Trunk Exchange. Calls for Europe proceed by land wire and submarine cable; but those for Australia go from the Trunk Exchange by wire to the transmitting station at Rugby, England, where they are again put on the air as radio waves for the passage to Sydney, Australia. Connections for messages going westward to New York, or between New York and South America are made in a similar manner.

THE connection across the Atlantic in 1927 was established by means of long-wave radio using a wavelength of about 5000 meters between a transmitting station at Rocky Point, Long Island, and a receiving station at Wroughton, England, and a transmitting station at Rugby, England, and a receiving station at Houlton, Maine. The European long-wave station was changed to Cupar, Scotland, during 1927, the reception being better in that latitude.

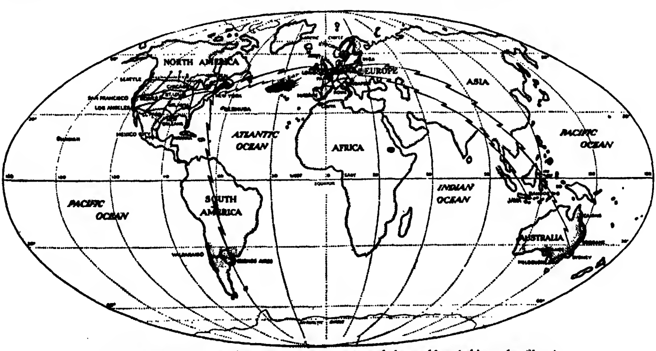
Four radio channels now handle transatlantic conversations: One long-wave, at about 5000 meters, and three short-wave channels in the band between 15 and 44 meters. These are operated jointly by the American Telephone and Telegraph Company and the British Post Office. Another long-wave channel is planned. Connection to Australia is established by another radio circuit from England, while Java is reached through radio stations in Amsterdam or Berlin. One short-wave channel using wavelengths between 14 and 28 meters handles the traffic to South America. This latter is operated jointly by the American Telephone and Telegraph Company and the Compania Internacional de Radio of Buenos Aires.

Short-wave receiving set on European and South American circuits, at Netcong, N. J.

When transoceanic telephone service was first inaugurated most of the calls were made for the novelty of talking across the ocean, or for publicity reasons. The tide of these, therefore, rose and fell with each major extension. Commerce and industry rapidly recognized the value of this service, however, and have employed it to extend foreign sales, to take advantage of favorable conditions abroad for the purchase of materials or commodities, for keeping in touch with European representatives, and so forth.

Practically every important city in the two continents has been involved in the traffic. The prevailing language is English, although others are used with increasing frequency. Naturally, there are numerous "peaks," notably at the Christmas holiday season. The greatest peak occurred at the time of the stock market break in October, 1929.

The volume of calls of a social nature has been large: greetings exchanged between relatives or friends; plans for meetings and the thousand other things that enter into the social life of the individual. From the beginning American people in the United States and abroad have been the largest users of this service, perhaps because they have become more telephone-minded than other nationalities.



Overseas telephone connections of the principal cities of the world and ship-to-shore service

HOW ANCIENT IS MODERN MAN?

By J. REID MOIR

Society of East Anglia

Figure 1: **Estuary of the River Orwell in eastern England, below which the skull on the opposite page was discovered. The country is low-lying**

IS it possible to furnish an answer to the important question as to how far back in geologic time the modern type of man can be traced? As is well known, toward the close of early paleolithic times large areas in western Europe and elsewhere were peopled by a remarkable race of human beings possessing in their bodily form marked and fundamental differences from that of *Homo sapiens*. These primitive hunters, the Neandertalers, with their large though simian-like skulls and strange limb bones, were practising a culture known as the Mousterian, and the deposits in which the remains of this epoch are found are in many places immediately succeeded by beds containing the industrial relics of another and quite distinct civilization—the Aurignacian. In the accumulations of this last-mentioned epoch a number of human skeletons have been discovered, and when these are compared with the bones of the Neandertalers who immediately preceded the Aurignacians it is obvious even to a novice in such matters that the two races of men represented differed fundamentally in their physical characteristics.

NOW it is to be remarked that the lapse of time between the Mousterian and the Aurignacian cultures cannot well have been, geologically speaking, very great. The Aurignacian deposits are often found lying actually superposed upon those of the Mousterian and, even if it were physically possible for a Neandertal type of man to develop into that of the Aurignacian (*Homo sapiens*), which many skilled anatomists deny, it does not seem credible that such a marked transformation could have taken place in the comparatively short period of time intervening between the Mousterian and the Aurignacian epochs.

Taking these matters into consideration it would appear probable that the genesis of modern man must be looked for in some period pre-dating that of the Mousterian, and the question at once arises as to whether, up to the present, this supposition has been found to be correct. There is, of course, no doubt that numerous claims have been made to the discovery of human remains of the "modern" type, and of a pre-Mousterian antiquity.

Perhaps one of the best known discoveries of this order is that made a number of years ago of parts of a human skeleton embedded in one of the deposits of the 100-foot terrace of the River Thames in England at a place called Galley Hill. These remains, which clearly represent an individual of the modern type, were seen in place by several reputable people. The bones rested at about eight feet from the surface, and appear to have come from stratified and undisturbed beds which are known to be older than those of the Mousterian period when Neandertal man lived.

Then again, there is in existence in the Museum at Bury St. Edmunds, Suffolk, England, a portion of a fossil skull found at Westley near Bury, at some depth in brick-earth and associated with the remains of the mammoth. This skull fragment is certainly not of the Neandertal type, and as flint implements of late Acheulean forms occur in the brick-earth from which it was recovered, it would seem that the Westley individual, though to be classed as an example of *Homo sapiens*, nevertheless lived prior to the Mousterian epoch.

Other discoveries, such as those made at Clichy near Paris, Denise in south France, and Olmo and Castenedolo in Italy, appear to support the evidence afforded by those made at Galley Hill and at Westley in England, and it is plain, therefore, that there is in existence a considerable body of evidence in favor of the view that long before Neandertal man overran western Europe people of the modern type existed there.

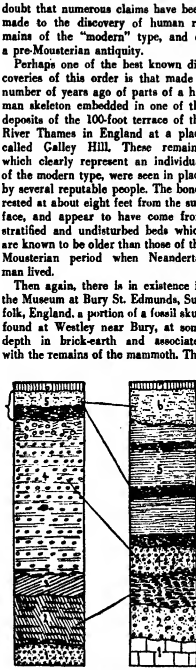


Figure 2: **Old land surface in East Anglia. The section at left is from the Gipping Valley, and that on the right from the Orwell estuary**

I WOULD here wish to state frankly that I have never been able to accept the notion that the remains of *Homo sapiens* are to be found only in deposits later in age than those containing the bones of *Homo neanderthalensis*. This seems to be an intrinsically improbable supposition and one not to be made otherwise by the easy method of refusing to accept as authentic any remains of man of the modern type discovered in beds of a pre-Mousterian antiquity. I have endeavored, therefore, to preserve an open mind upon this important matter and to take due cognizance of any discoveries seriously claiming to support the conclusion that *Homo sapiens* is of great antiquity.

During the last two or more years I have been investigating the low-lying and deeply buried deposits of the River Gipping and its seaward and tidal extension the Orwell at Ipswich, England. These investigations have brought to light certain evidence having a distinct bearing upon the problem outlined above, and it is the main purpose of this article to lay this evidence before the readers of the SCIENTIFIC AMERICAN. Hitherto, the archeological contents of the beds in question—owing to their water-logged condition and general in-

Illustrations by permission of the Prehistoric Society of East Anglia.

accessibility—have been practically unknown. But, through a series of commercial undertakings in the Gipping Valley and by the dredging operations carried out recently in the Orwell estuary, it has been possible to unfold a truly remarkable picture of early man in East Anglia. I propose in this article to confine myself to a description of the archeological remains found in the lowermost implementiferous horizon of the deposits mentioned.

These remains come from an ancient land surface inhabited by early paleolithic man at a time when East Anglia stood much higher above the sea than it does today. The old land surface to which I refer is now buried deeply beneath a succession of beds in the upper non-tidal part of the Gipping Valley (Figure 2, at left) while in the Orwell estuary it is sealed in by upwards of 38 feet of compact peat, gravel and silt submerged by a considerable depth of water at high tide (Figure 2, at right). In the Gipping Valley the old land surface has yielded large numbers of flint implements, flakes and cores, and the hand axes of this group without question are of the same heart-shaped or cordate type as those found at the well-known site of Combe Capelle in France (Figures 3 and 4). This industry links the Acheulean with that of the earliest Mousterian and is in date definitely prior to that of the late Mousterian where Neandertal man lorded it in western Europe.

ACCOMPANYING the Combe Capelle specimens in the Gipping Valley have been found the remains of a mammoth of the broad-toothed variety such as Depéret claims to be of an early type, while in the compact and deeply buried peat of the Orwell estuary numerous fine examples of the same kind of elephant molars have been recovered. Further, an examination of the fossil plant remains from the two horizons, which moreover are geologically comparable, shows that there is no great divergence between them, and it may be claimed that in all probability the compact peat of the Orwell estuary and the peaty clay of the Gipping Valley represent but different parts of one and the same deposit (Figure 2).

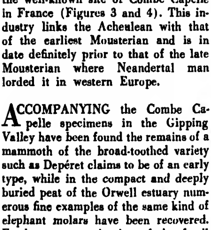


Figure 5: **The Orwell skull, which is probably of early stone age date**

Now there has been preserved in the Ipswich Museum for many years a human skull (Figure 5) which has every appearance of having been derived from a bed of peat. Unfortunately when this specimen was acquired no exact data were recorded as to its provenience and it bears a label stating "probably dredged from the river"—the river indicated being the Orwell (Figure 1). When the skull was first brought to my notice, I was at once impressed by its weight and appearance. The general color is grey while in places the outer layer of the bone is preserved and is of a chocolate brown color due almost certainly to staining by peat. In order to have a chemical analysis made of the bone, a small part was excised and it revealed the fact that the cancellous or spongy appearing structure exhibits throughout its thickness the same grey color as is shown by the outer surface of the skull. In one of the frontal sinuses traces of a fine silt-like material, such as is found in peat, are present. The piece of skull removed for examination, together with another from the

Figure 4: **Another Gipping cordate ax of the type shown above**

limb bone of a mammoth recovered from the compact peat in the Orwell estuary, have been analyzed by expert chemists, and the amount of organic matter contained in both specimens found to be almost coincident. On the other hand, an analysis of different bones from the Orwell estuary, of later date than those in the compact peat and also of "green" or fresh examples, shows that these contain a much higher proportion of organic matter. These results have made it clear that the skull in question is without doubt in a fossil condition and taking all the evidence into consideration, is probably of Combe Capelle, that is, early Paleolithic age.

In view of this conclusion I submitted

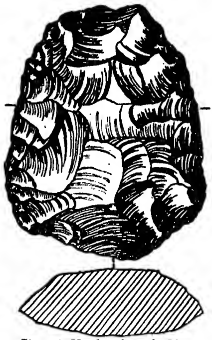


Figure 3: **Hand ax from the River Gipping, like Combe Capelle type**

the specimen to Dr. W. L. H. Duckworth, the well known anatomist of Cambridge University, for examination. Dr. Duckworth, to whom I am very grateful for his kindness, reports that the skull stands out quite definitely as an example referable to *Homo sapiens*, the modern type of man.

Dr. Duckworth also draws attention to the close agreement in form of the Orwell skull to one found many years ago at a considerable depth when making a dock at Tilbury in the Thames Valley. The Tilbury skull occurred, in fact, at a similar horizon to that occupied by the compact peat in the Orwell estuary. The Tilbury skeleton was described by Sir Richard Owen, F.R.S., who claimed for it a paleolithic antiquity and ascertained, by means of chemical analysis, that the bones were fossilised. Moreover, at Tilbury and at other places in the bed of the Thames, there have been dredged up examples of Combe Capelle hand axes quite comparable in form with those found in the Gipping Valley, and it is therefore possible that the Orwell and the Tilbury skulls are of the same age.

AS I have endeavored to show, both of these skulls may be of the Combe Capelle Lower (early) Paleolithic period, and if this opinion should turn out to be well founded then two more specimens of the type of *Homo sapiens* must be added to the growing list of such examples from pre-Mousterian deposits. In any case I am strongly of opinion that it is necessary to place on record any discovery which seems to point seriously to the great antiquity of modern man, and it was with this end in view that the above article has been written.

COTTON CLOTH FIT FOR A KING

By DONALD A. LAIRD, Ph.D., Sci.D.
Colgate University

SILK purses may not be made from pigs' ears, but industrial science performs daily almost as great a miracle in finishing cotton fabrics. From the identical strip of greyish-tan weave, the finisher can produce a soft nainsook, a rough muslin, a smooth and polished cambric, or a lustrous mercerized fabric. From the same fiber, sateen is produced by a few variations in the finishing processes. Startling and unexpected results are a matter of daily routine in the preparation of practically every cotton fabric for the consumer.

The cotton fiber becomes fit for a lady or a king by being subjected to hard knocks which produce softness, luster, or smoothness. The cloth is burned, passed through vinegar, caustic, or even through sulfur compounds. The hard knocks are literal in some types of finishing, particularly when a softness is obtained by passing the cloth between two dozen wooden rollers, each of which is studded with more than a hundred brass knobs which beat the fibers into softness.

WHEN one admires a particularly soft and fluffy blanket it is probably not the actual beating process that has produced the delightful softness, but the use of sulfonated castor oil in the finishing processes. Each fiber absorbs only an infinitesimal amount of this oily compound, but an olfactory examination of the fluffy goods will betray the cause of its unusual softness. The use of oils, however, is essential to textile manufacture for other reasons than giving the finished product the appealing virtue of softness. In order that yarns can be woven readily and accurately, tallows, oils, starches, and glues have to be added, depending upon the nature of the fibers.

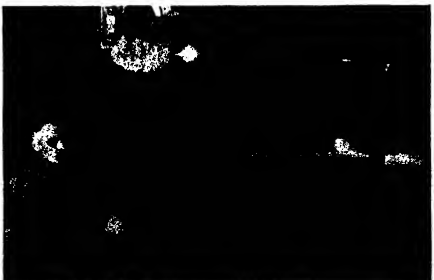
The virtue of applying diverse finishes to the same piece of cloth has resulted in the peculiar profession of the convertor. The convertor will purchase thousands of yards of unfinished fabrics from weaving and spinning mills and will arrange with finishing mills and bleacheries to finish the fabric in the way the convertor thinks will best satisfy his customers. The weaving mill may be in the South and the finishing mill a thousand miles to the north, but the finish of the cloth is so important that it is often hauled almost the depth of the country.

This is a part of the price that is paid to satisfy man's desire for the beautiful and comfortable, but usually it amounts only to a fraction of a cent a yard. The textile world awakened to the sales values of finishing goods long before soap manufacturers, for example, realized that a shapely, smooth textured, fragrant, and carefully colored cake would sell better than the same soap not "dressed up." Now practically every manufacturer is interested in effective means of dressing up his products.

There is nothing especially modern or civilized about finishing textiles to yield added beauty and comforting softness to the wearer. Our grandmothers were adept at beautifying the unbleached goods they purchased. The goods were boiled again and again in hot suds, but this was not enough to make them white or soft. Then the material would be spread on the grass, on sunny days, and sprinkled from time to time. Frequently the pieces were turned over and shaken vigorously. Sometimes lye would be used. Then—hoping for the best—she would try dyeing them. The bleachery and dye house and finishing plant have taken over the task and do a much better job than grandmother did, despite all the patience and labor she put into the effort.

The Chinese coolie in British Malaya has his own primitive procedure for finishing his fabrics so that he will be proud to display them. First he boils the material in oyster shell lime to remove starches and other impurities, and then rinses it in clear water. Then it goes into a glue solution made by boiling water buffalo skins until they have dissolved; and again it receives a rinse in clear water. Then the fabric receives an aromatic bath in water in which pineapple skins have been soaked for two days, following which the glue odor is further offset by being dipped in a solution in which mangrove bark has been cooked. In the final step in the finishing process, the fabric is wrapped firmly around a small smooth log which fits into a smooth wooden trough and the calendering polish is given by a stone weighing from 700 to 1000 pounds.

IN a modern American finishing plant, we find much the same processes, although many variations and refinements have been devised. One of these, for example, is the singeing process, the first used on most smoothly finished goods. The cloth is whirled close over burning gas jets which burn off the excess woolly fiber. This singeing, directly in contact with the open flame, takes place while the fabric is traveling at the rate of a rapid trot, too rapid usually for the material to burst into flame; but in case it does, negligible damage will be done because, three feet from the flame, the fabric passes into a liquid malt bath which also facilitates the process of dissolving the excess starch.



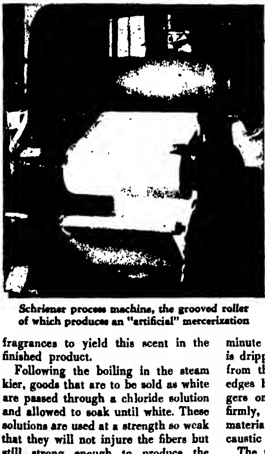
Courtesy Utica-Willowvale Bleacheries

A singeing machine which burns the nap from cloth as it passes rapidly over a flame. Material passes through large eyelet, in upper left, after wetting

Still at a good speed, the apparently endless fabric passes from its brief wetting-down dip in the malt solution, through large eyelets the size of a small life preserver to a large kier which has been filled with caustic soda, ash, and lime. Sometimes strong liquid soap is used; and in case the goods have already been dyed, they are passed into a peroxide kier so the color will not be changed.

For the last operation, the modern bleachery uses large steam kiers under 10 pounds pressure, giving a temperature much above that of boiling water. To facilitate cleansing, some bleacheries mix pine oil with the soap for "wetting out." More recently they have begun using terpineol, which accomplishes the same results and also impregnates the fabric with a scent suggesting lilac or lavender. One manufacturer is actually selling sheeting under the name of "lavender" due to the use of synthetic fragrances to yield this scent in the finished product.

The edges of table cloths, shrunk to 36-inch width, are grasped by automatic fingers on this belt, and given a mercerized finish by stretching to 42 inches width



Schriener process machine, the grooved roller of which produces an "artificial" mercerization

Following the boiling in the steam kier, goods that are to be sold as white are passed through a chloride solution and allowed to soak until white. These solutions are used at a strength so weak that they will not injure the fibers but still strong enough to produce the bleach. When the bleach is satisfactory, the goods are passed through the life preserver rings again and into a bath of sulfurous acid, to neutralize the chloride solutions. This acid has to be thoroughly washed out to offset the later development of sulfurous odors. Washing the goods after the various steps in the finishing process is so important that a medium-sized finishing plant will use as much as 3,000,000 gallons of clean water daily.

When animal fibers are being finished, alkalis cannot be used since they tend to destroy the animal fibers. The excess of natural fats must be removed, however, to prevent souring of the material. In some of the fat-removing processes, the extracted fats are carefully saved and sold as a by-product, since the lanolin they contain is used in beauty creams and ointments, with the odor of the animal fat scientifically disguised.

One of the most interesting processes may be observed in the production of a mercerized cotton fabric. Just what produces the luster of mercerization is unknown; that is a secret the silkworm has, but man can now make the luster artificially. A permanent mercerization that will withstand severe laundry treatment is produced by shrinking the woven cloth in caustic soda and then gradually stretching it for a minute or two while the excess caustic is dripping out. As the fabric emerges from this solution it is seized at the edges by hundreds of mechanical fingers on endless belts; these hold on firmly, stretching the width until the material is ready to have the remaining caustic washed out in clear water.

The theory of mercerization is that the curl is taken out of the fibers, although authorities are in dispute on this point; but at any rate it produces a permanent finish. A similar finish is sometimes produced when the original yarns are stretched as they are spun.

An artificial mercerization which will wash out is the result of the demand for appearance and cheapness. The cleansed goods are moistened and passed between the rolls of a Schriener calender under a pressure of about 80 tons. One roll is smooth, the other has from 200 to 300 fine lines per inch engraved on its surface. These make minute cuts in the surface of the goods which give it a sheen or luster but do not give it a polish. Polish, independent of mercerization, is achieved by having one roll go faster than the other, using both heat and pressure. This, obviously, simply duplicates household ironing.

In the dyeing processes, the utmost skill is required, not only to keep the colors under accurate control but to guard against the development of undesirable odors. Most blacks, khakis, and dull colors, for example, are obtained by the use of dyes for which sodium sulfide has to be used as a carrier. These fabrics are carefully processed and washed to avoid developing the sulfurous odor of old eggs.

THE fastness or permanency of dyes now gives but little bother, but the color and odor are still of great concern. Ever since William Henry Perkin started the use of aniline dyes "that dye odor" has been a laboratory phrase and in some instances it is possible for experts to tell the color by the smell of the goods. Dr. Eric C. Kunz, an American chemist, is now at work adding to the finishing touches of fabrics by neutralizing the dye odor. In one plant, artificial wintergreen has been used in some of the processes, and these departments quickly became the most popular among workers, indicating the merits for building worker morale as well as adding sales value to the merchandise.

This appears to be in line with the growing desire on the part of fashion leaders in quest of "something different" and completely appealing to the senses to have dress goods delicately scented. Early this year frocks appeared on Bond Street which were impregnated with permanent scents as a triumph of applied research. From Paris we learn that this is considered more than a venturesome fancy and has been seriously taken up by several famous arbiters of fashion.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

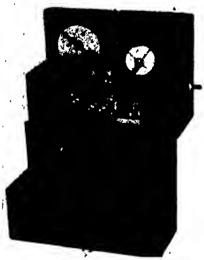
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

New Soap Has No Taste

A SOAP that has neither taste nor smell has recently been developed by synthetic chemists. Not only is it harmless when taken internally but it has a food value very similar to lard. Chemically it is known as glycol stearate.

Since nearly all tooth pastes and powders contain a large proportion of soap, it is necessary to mask their taste. This is done by the addition of sugar or saccharine and oils like peppermint or wintergreen. If glycol stearate is used these masking agents are unnecessary.—*A. E. B.*



The Strowger telephone call recorder makes a note on tape of calls to a 'phone from dial telephones

A Telephone Call-Recorder

A RECENT development in "dial" telephone equipment comes to the aid of doctors, lawyers, and other professional men who have no assistants and have to leave their offices unattended during their absence. This development is a call-recorder which provides a much-needed service not practical with "manual" operation.

This call-recorder consists of a pen-register which is installed at the subscriber's telephone with a switching key to throw it into service when the subscriber leaves. When ringing current is put on the line by an incoming call, it starts the pen-register and sends a distinctive tone to the calling party, indicating that the called party is absent but has a call-recorder ready to record his telephone number.

The calling party then proceeds to dial *his own* number, and the pen-register records it as a series of short dashes on a tape. If the call number includes letters, these are recorded as figures, but as the number may be called again by these same figures, there is no confusion. After the last digit is completed, the register feeds out about three inches of tape, to separate this number from any which may follow.

Bran and Constipation

AVOIDANCE of constipation, which he describes as "one of the most prevalent American diseases," is best secured by including a sufficient amount of bulky food in the diet to stimulate the intestine to normal activity; and bran, recently criticized by some doctors, is a perfectly suitable food for this purpose, according to Dr. L. H. Newburgh, Professor of Clinical Investigation in Internal Medicine in the University of Michigan.

"The muscles of the large intestine where food refuse accumulates must contract in a definite way to insure normal action. These muscles will not contract, however, until they have been stimulated by stretching to a certain degree, and this stretching can only be brought about by a sufficiently large mass in the intestine."

Before 1870, when modern milling processes were introduced, the large intestine was assured of an adequate amount of bulk because the bran or chaff was included in the flour. With the coming of the roller mill at this time, the public was offered white flour, a product from which all bran was removed. At the same time there was a general tendency toward other highly refined, soft, smooth foods, largely eliminating all roughage except certain green foods such as lettuce.

"Striking examples of the effect of eliminating bulk from the diet were frequently furnished when large groups of immigrants were entering this country," stated Dr. Newburgh. "In treating a large number of constipation cases among immigrants from southeastern Europe at the Massachusetts General Hospital, we made a special study of their food habits. In their native country, we found, they had lived largely on coarse rye bread, made from the whole grain, and green vegetables. As soon as they arrived in America they adopted a white bread and beef steak diet, and were much opposed to giving up what were to them food luxuries. As a result, a large number soon developed very severe cases of constipation which were corrected by a return to a diet containing bulky foods.

"It seems necessary that human beings, because of the nature of the muscles of the intestine, must include a considerable amount of bulk or roughage in their diet to be well. Bran is a convenient form of making this addition, and unquestionably does promote normal bowel movement."

Two-Point Rubber Mounting of Automobile Engines

SINCE the early days of the motor car, engineers have sought to eliminate roughness and vibration from the four-cylinder automobile engine. While cylinders have been added and the industry has sponsored sixes, eights, and other multi-cylindered engines, Plymouth engineers

Two-point suspension of the engine in the new Plymouth car, showing rubber mountings and the stabilizer

With good lighting, indoor movies may be made with the new panchromatic film—lens opening f.1.9

have worked on unceasingly for a perfected four. They realized that the four is the most economical and the simplest of all gasoline engines. The four has been accepted as the ideal car at the lowest price—except for vibration.

a of Fred M. Zeder vice-president in charge of engineering of the Chrysler Corporation, floating-power, a new method of mounting the engine, has been developed for the purpose of eliminating the last vestige of engine vibration from body and frame. A new line of Plymouth cars, with the complete power plant literally floating in the chassis has recently been announced.

Floating-power involves the use of only two rubber engine-mountings as compared with three or four ordinarily used. The rear rubber mounting is located in the cross member at the rear of the transmission. The front rubber mounting is located just under the water pump and is supported on a specially constructed triangular bracket attached to the front cross member. A line connecting the rear and front mounting points would pass through the center of gravity of the power plant, like the shaft through a balanced fly-wheel as shown in one of our drawings; thus the entire power plant is suspended in perfect balance.

To preserve the proper alignment of the hold the movement of the engine the limits allowed by the rubber mountings, a built-up cantilever spring is used between the rear of the engine and the frame side member. The built-up end of this spring is attached rigidly to the engine and the other end is embedded in rubber in the frame side member.

A glance at the Plymouth engine while running at various speeds shows very clearly the "float" of the power plant. By permitting the power plant thus to rock freely on its natural axis, the vibrations normally transmitted to the frame and body are dissipated.

Combined with floating-power in the Plymouth is another of the industry's latest innovations—free wheeling in all forward speeds. This free-wheeling unit was developed by Plymouth engineers and differs in design from other such units now in use. Its operation is controlled by a button on the instrument panel and it may be locked out simply by pulling on

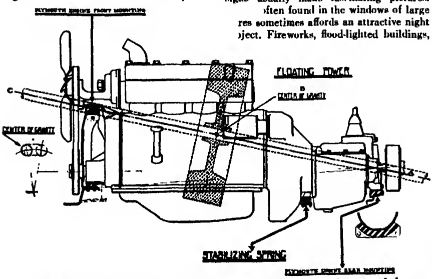
In addition to floatir wheeling, the new Plym shift transmission of t type; safety-steel bodie shaped on giant presses with each cally welded into one rigid double-drop frames, to provide exceptio lowness, excellent roadability and ease o control; and internal hydraulic, self equalizing brakes.

Supersensitive Panchromatic Home-Movie Film

THE recent introduction of Ciné-Kodak Supersensitive Panchromatic Safety Film enables the home-movie maker to take motion pictures of subjects that could not be photographed satisfactorily before. Pronounced sensitivity at the red end of the spectrum makes the emulsion of this film particularly efficient when exposed to rays of artificial light—especially the light of incandescent lamps. As a result, the range of Ciné activities is signally extended.

With supersensitive panchromatic film, it is now possible—in fact, easy—for amateurs to photograph indoor subjects by the light of ordinary electric lights. The increased range of picture taking provided by this film actually embraces night scenes on brilliantly lighted streets, or theater districts in large cities Animated electric signs usually make fascinating pictures. often found in the windows of large res sometimes affords an attractive night ject. Fireworks, flood-lighted buildings, camp-fire scenes, are all now within the scope of night movie making.

The new film is valuable for daylight photography as well as for pictures at night. The increased light-sensitivity of the film is not confined altogether to the red end of the spectrum. It is nearly twice as responsive to blue and ultra-violet light as regular panchromatic film, permitting successful pictures to be made under very adverse weather conditions. Unusual shots can be made during a downpour of rain with super-sensitive film, and the Ciné camera now becomes an efficient instrument during the early hours of the morning or in the weak light of the late afternoon.



The "fly-wheel" effect in the new Plymouth car. The engine is suspended so that a line through the points of suspension passes through its center of gravity

Cancer Survival

MORE than half of the women given radium or X-ray treatments after operation for cancer of the breast had no recurrence of the disease for five or more

Remarkably clear outdoor night picture made with the new film

years, Dr. George E. Pfahler of Philadelphia has announced in a review of 1022 cases of cancer of the breast reported to the American Radium Society. Physicians require that patients be free from cancer for at least five years after treatment before concluding that the treatment has been successful. For this reason Dr. Pfahler's report was received with great interest.—*Science Service.*

"Butter" in Rainbow Colors Next?

OLEOMARGARINE of rainbow hue, supercharged with extra vitamins, is an experiment that may be tried out to extend the market for that butter substitute. Frustrated by recent enactment of the law imposing a 10 cent per pound tax on yellow margarine made from palm oil, manufacturers are said to be giving serious consideration to adopting a new distinctive color for the product.

This may be red, green, amber—any color that is recommended by a study of the technical and psychological factors involved. Whether the public will respond to a spread for bread that is not of the traditional yellow color is the question to which the margarine makers are seeking a definite answer. They may get it by marketing various colored samples in one or more small communities.

Margarine richer in vitamin A and D content than butter, made by adding deodorized cod-liver and other fish oils,

vegetable oils, oils from beef liver and other substances, is being produced by certain manufacturers in Germany, Holland, and England. Domestic manufacturers now are engaged in research along this line.

Results of the 1929 distribution census for oleomargarine and other butter substitutes were released by the Census Bureau

After the record-breaking flight around the world: Gatty (left) and Post (right) holding commemorative plaques awarded them by the Aeronautical Chamber of Commerce

recently and show that 41 plants in the United States produced 46,522,000 dollars' worth of oleomargarine and other butter substitutes.—*A. E. B.*

Trout Digests Hook

A LETTER received recently from C. E. Hagie, of Western State College of Colorado, Gunnison, recorded such an unusual incident that we thought our readers would be interested in hearing of it. He wrote:

"While fishing last evening in the Gunnison River just below the town of Gunnison, Colorado, I caught a Loch Leven trout about 12 inches long. As I drew my hand along his side I felt a sharp point protruding just beyond the surface of the skin. Upon cleaning him I found a half inch of the barbed end of a fish hook protruding through the side of the stomach. I pulled on it and found that the part of the hook which remained in the stomach had been entirely eaten away by the digestive fluids, except for a short thread-like stem about a quarter of an inch long. The hook was of the tempered steel, snelled type which originally had a shank about an inch and a half long and a distance from barb to shank of about one half inch. The fish was in fine condition and put up a strenuous fight against being landed."

Viosterol Found Beneficial to Radium Poisoning Victims

ALMOST simultaneously with the news of the 20th death from radium poisoning among the unfortunate watch factory workers, comes the announcement of a promising method of treating the condition. Viosterol, now often given infants in place of cod-liver oil to prevent or cure rickets, has benefited a number of victims of radium poisoning, Dr. Frederick B. Flinn of Columbia University has reported to the American Medical Association.

Dr. Flinn does not consider that he has a cure for the condition, but merely reports a method of treatment that has given promising results.

"Our experience so far suggests a method of treatment that will eliminate radium salts from the organism as well as improve the condition of the bones if continued for sufficient time," he stated. "It is a matter of months and not days. Care should be taken that fresh preparations are used," he cautioned.

Most conspicuous among radium poisoning victims were the dial painters in the watch factory whose habit it was to put their radium-paint brushes in their mouths to point them. In this way radium got into their bodies and in about one fifth of them the radium was deposited in the bones instead of being eliminated from the body. While the amounts of radium absorbed in this way were small, the activity of radium is so great that these small amounts were sufficient to destroy bones and tissues and to cause fatal illness.

How to get the radium out of the body before it had caused irreparable destruction was the problem which Dr. Flinn and other scientists attempted to solve. Because radium is related to calcium, it was supposed that any treatment that would affect calcium might have a similar action on the radium deposits, Dr. Flinn explained. So he first tried treatment with an extract of the parathyroid glands. These small glands, located behind the thyroid in the neck, are thought to regulate the calcium of the body.

Parathyroid treatment had been moderately successful, when Dr. Flinn suggested the use of viosterol. Vitamin D, calcium utilization in the body, bone formation, and the parathyroid glands are all linked together, so viosterol, which is a potent source of vitamin D, was a logical selection.

The results of this treatment in eight cases have been good. In two cases, radium was completely eliminated from the body; in the other six, the amount of radium was materially reduced. Improvement in general health, such as freedom from pain, gain in weight and improved condition of the blood, followed the treatment, and one of the patients was able to resume her former housekeeping activities. In most of the patients the destruction of bone was checked.—*Science Service.*

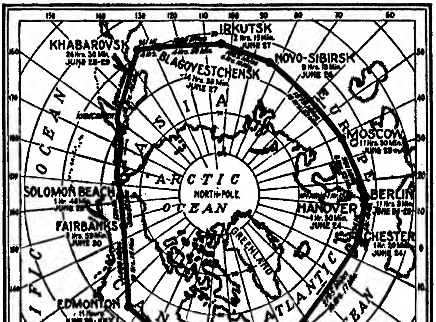
Cold Storage Use Expands

THE broadening place which cold storage occupies in food preservation as a result of the accurate control of temperature, humidity, and circulation now possible is shown by the growing list of products for which it is used, says J. Leo Cooke in a recent issue of *Food Industries.*

Of course you are all aware of the fact that meats, fish, butter, eggs, poultry, apples and pears, and green vegetables go into cold storage. But this does not exhaust the list by any means. Fresh cream is now stored successfully and cake, candy, and nuts also go into storage.

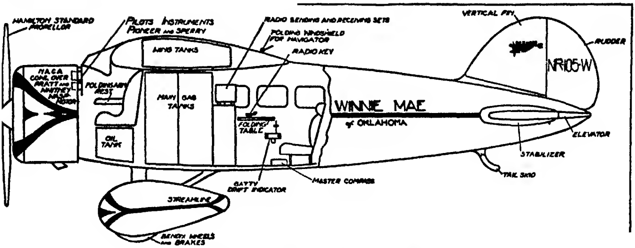
One large restaurant puts its watermelons in cold storage during hot weather to chill them. This saves a lot of ice when the melons are placed on the counters. Dried mushrooms are another product found in storage.

Tests have been made recently in keeping sponge cake and pound cake in cold storage. It works perfectly. Fruit cakes



Courtesy The New York Times

The route of Post and Gatty around the top of the world. The time of take-off from each airport, distances, hours in the air, and hours in port are all shown



Partially skeletonized view of the *Winnie Mae* showing general arrangement

and plum puddings are sometimes aged in cold storage to give them the proper flavor. Suitable storage facilities not only arm us against the onslaught of famine but also act as a leveler of the peaks and valleys in the price curves. It is, in short, insurance against shortages and against soaring prices.—*A. E. B.*

Around the World in Nine Days

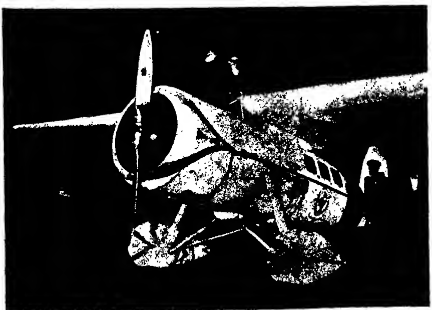
AVIATION history of the kind that takes into account pluck and physical endurance, skillful piloting, perfect navigation, and a dependable plane, was made when Wiley Post, pilot, and Harold Gatty, navigator, flew the airplane *Winnie Mae* around the top of the world in 8 days, 15 hours, 51 minutes, completing the trip at Roosevelt Field, New York, on July 1. Post is 35 years old, a former Texas farmer and oil driller who took up flying after losing an eye in the oil fields. Gatty is 30 years old, a former navigator on a merchant vessel—having graduated from the Royal Australian Naval College at 17—and a former operator of an air navigation school in Los Angeles. F. C. Hall, the owner of the plane and backer of the flight as a "sporting proposition," is an oil man of Oklahoma in whose employ Post has been for several years.

In its dash eastward from New York across the Atlantic and thence across Europe, Siberia, the Bering Straits, Canada, and back home again, the *Winnie Mae* made many records. Post and Gatty broke the transatlantic time record for air crossings that has stood since the flight of Alcock and Brown, the first airmen to make this hazardous non-stop trip. They cut the *Graf Zeppelin's* 'round-the-world flight record to one third, and beat the dirigible's time to Germany by 31 hours, 14 minutes. According to calculations, the total mileage of the *Winnie Mae* was around 16,000 miles, and the average speed for the entire distance was 145 miles an hour. It is said that hitherto no human beings have ever maintained such a speed for so long a time or so great a distance. No airplane had ever before traced the full circumference of the northern hemisphere, and none had ever been around the world at so great a speed. Finally, no schedule so involved had ever before been carried out with any success.

The record-breaking ship is a high wing Lockheed monoplane built by the Lockheed division (Los Angeles) of the Detroit Aircraft Corporation. The fuselage contains the cockpit, cabin, and extra fuel tanks. Under a special cowl in the nose is a supercharged Pratt and Whitney Wasp engine of 525 horsepower at 2200 revolutions per minute. It is a nine-cylinder, air-cooled radial model similar to those used in military service in the United States.

The *Winnie Mae* is equipped with a large number of the most up-to-date instruments available today. Dials showing operating oil pressure, temperature of oil, fuel, cylinder heads, and of the leading edge of the wing, and pressure and contents of each compartment of the fuel tanks clutter up the dash board to such an extent that only a pilot such as Post proved himself to be could understand them all. An airspeed indicator, a rate-of-climb meter calibrated in feet per minute, gyroscopic bank-and-turn indicator, a double set of compensated compasses, and a Sperry "artificial horizon" are some of the other instruments used to assure correct piloting and safety.

The plane also is equipped with a radio set which provides for short-wave transmission of messages in code, and long- and short-wave reception. On the 'round-the-world flight, Gatty, who was in the cabin with his instruments, communicated navigating directions to Post, who was in the high cockpit forward, by means of a telephone.



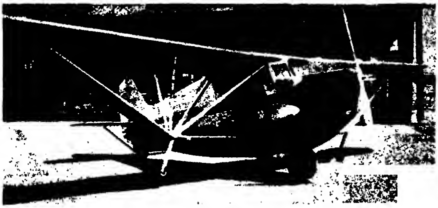
At the beginning of the flight, Post waves good-bys at Roosevelt Field

A Land Catapult

IT is interesting to learn from *The Aeroplane* (London) that the British Royal Aircraft Establishment has been experimenting with a catapult for the launching of landplanes.

In this device a steel cable is wound on a drum and the drum is geared to a compressed air engine. The cable is connected by quick-release hooks to the underside of the fuselage of the plane to be catapulted. This cable is carried forward to a four-foot pulley anchored in the ground at the end of the run, about 100 feet in front of the airplane. It then goes round the pulley and back to the catapult drum.

As the drum turns, the airplane is pulled toward the pulley and at the end of the run the retarding mechanism in the catapult releases the cable hooks and the trolley on which the tail end of the airplane has been supported. Meanwhile the engine has been running at full power and the propeller delivering its full thrust. The whole operation takes about three seconds and there is very little danger of failure. The



A novel single-wheel plane designed by Charles Ward Hall

engine is driven by air at 1800 pounds per square inch; it develops 3000 horsepower for the short period it is in use; and its speed rises from zero to 2500 revolutions per minute in two seconds. While the new apparatus is somewhat cumbersome, it may have its uses in launching a heavily loaded bomber, or in sending one of our transatlantic flyers off on his journey.—*A. K.*

Airports for Small Cities and Towns

AT a recent meeting of the American Society of Mechanical Engineers, E. L. Wheless discussed comprehensively the airport problem for small cities. There is no doubt that the popularity of flying is increasing and that almost any city or town is all the better off for having an airport. The reason that small cities are apt to fall behind in this respect is because there is difficulty in obtaining information both as to costs and procedure. All the published information deals with the ambitious plans of large cities. The results of airport design competitions, when described in the press, are apt to give an impression of magnificence and large expenditures. As a matter of fact, an airport adequate for all private flying, for feeder line operation to the great air routes, and for emergency landings of large, heavily loaded transports, is not such a difficult undertaking.

The requirements for a small city airport may be roughly summarized as follows:

Good meteorological conditions, particularly freedom from smoke and fog.

Good approaches to the field.

Since artificial runways are expensive, a firm level surface where tough sod can be grown is important.

Accessibility and utilities are needed, just as in the large airport.

The minimum size of field is 40 acres.

Runways 2500 feet long in the direction of the prevailing winds, at least, are essential.

Drainage is expensive, and selection of terrain from this point of view is advisable.

Lighting is likely to be nearly as expensive for the small airport as for the large one, with a minimum cost of about 10,000 dollars.

Hangars should be steel. It is unwise to invest in expensive masonry.

The waiting room may, at a pinch, be a simple lean-to adjoining the hangar proper.

A filling station is a necessity.

If a committee of pilots, engineers, and business men can be made to work; if sites are advertised for and not secured by private barter; if the Department of Commerce is consulted; if a competent airport engineer is employed at least to check plans; if hangar manufacturers and airport lighting companies are freely consulted; if the community as a whole participates heartily, then the small city can readily and cheaply secure an airport for itself. This may not pay at first, may even appear as a "white elephant," but in the long run, the possession of an airport will be a great help to the development and continued prosperity of a small town.—*A. K.*

A Novel Plane

A NOTED airplane constructor, Charles Ward Hall, of Buffalo, is original in appearance, (he is nearly six and a half feet tall among other things), and always original and generally successful in his ideas. Just to please himself he has built the peculiar looking plane shown in one of our photographs.

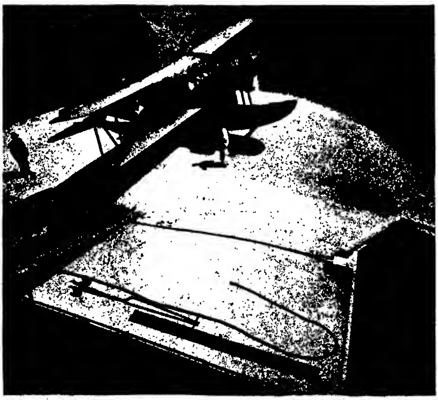
For want of technical detail it is interesting to speculate on what the characteristics of the craft may be, by closely studying the photograph. There is bnt a single main wheel; two tiny rollers on either side merely serve to steady the plane. This allows the head resistance of the undercarriage to be decreased. The main wheel is very near the bottom of the fuselage. We will wager that the fuselage is waterproof, that an emergency landing can be made in water, and that because the wheel is so near the bottom of the fuselage the land plane will not turn over when striking the water.

Mr. Hall has often stated that if there is to be any external bracing in his designs, then this bracing must serve a more useful purpose than just to hold the wing. Hence the horizontal brace shown between the fuselage and the junction of the wing struts, is a *lifting* section, more than paying for its head resistance. Again, the large strut running toward the tip of the wing is also a *lifting* section.

The joy-stick or control stick is suspended from the ceiling, instead of being mounted on the floor. To explain this, let us offer the following hypothesis. The joy-stick controls the ailerons, which are in the wing and the wing is on top of the fuselage. Therefore the joy-stick suspended from the ceiling provides a more direct connection to the ailerons which it actuates. If we are in error, these columns are open to Mr. Hall for correction!—*A. K.*

Seaplane Bases

A SEAPLANE base in the heart of a large city may be extremely useful. It may serve as the starting point for a convenient service between one city and another, as between Cleveland and Detroit, for example. Or it may be the home of an air ferry across a bay, as in San Francisco. Or it may attract visiting airmen to a sum-



The deep water "button airport" of Air Ferries, Ltd. at the end of pier at San Francisco. A Loening flying boat is seen stationed on the low platform

mer resort located on the water. Compared with a landing field, a seaplane base is a very simple matter.

Earl D. Osborn, writing in *Airports*, presents an illuminating study of various phases of this subject. There should be a clear space of water in front of the seaplane base, three quarters of a mile in length in its shortest direction if possible. Waters crowded with a multitude of small boats should be avoided; small boats are to be feared more than large ones because they so often steer erratic courses (there would be no fun with a small boat were it not erratic!)

The question of hangars is not dissimilar from that of hangars on a landing field. The main problem is the design and construction of a suitable ramp. The ramp or sloping platform can be built in a number of ways, and can cost anywhere from 50 dollars to as many thousands. In general the ramp should run some two or three feet below water. Its angle of slope should be about one in seven. If many passengers are to be discharged, the ramp should extend all the way up to the top of the dock or shore.

If cost is an important consideration, the width of the ramp need only be 15 feet, which is a little more than the width of the largest hull or amphibion gear. But since seaplanes are more affected by wind than power boats, and cannot always be maneuvered with the same nicety, a 75-foot width is not too much for handling traffic speedily.

Where the tide is powerful and rises and falls several feet, the ramp has to be considerably longer than where the tide is negligible, since at least a good portion of the lower end of the ramp must always be under water. Amphibion planes can put down their wheels and run up on a concrete ramp, but flying boat hulls or seaplane floats require a wooden ramp—which is also cheaper. With a concrete ramp it is necessary to lower a dolly on wheels into the water, place the hull on the dolly and haul the ship up with a tractor or winch. This means men with waders and is a long and annoying process.

With large rise of tide the expense of a seaplane base is considerable; sometimes it is found necessary to build a marine railway, or two sets of tracks extending under the water. A wooden platform is then let down on the tracks, the seaplane taxis on to the platform and is again somewhat slowly hauled up.

In this case of a large tide, or where land is expensive, there is another alternative—a floating shore ramp. The floating platform or raft has the advantage that it can be built on dry land and then launched into the water. The ramp of a floating platform is short, and as the raft rises and falls with the tide, there is no need to taxi up a long runway at low tide. The float ground crew are not forced to walk on the slippery part which is exposed by the tide, but passengers must walk down a sloping gangway on to the raft. Such a floating terminal is shown in our photograph. It is built in semi-circular fashion so that the seaplane can approach it from any direction. Such a semi-circular or "button" floating terminal has been used with great success by the Air Ferry in San Francisco, and is infinitely preferable to a barge.

We wish that a great many small cities and towns located on the water would consider this question of seaplane bases, which on a modest scale need neither millions nor bond issues.—*A. K.*

A Convenient Parachute Attachment

IN a closed cabin plane, where quarters may be cramped, it is not always possible to wear a 'chute. In Army planes, the observer or gunner may be required to stand up to operate a machine gun or to attend to photographic apparatus, and he

Close-up of the parachute harness showing the small female fitting

may be even harder put to it to wear a parachute than the occupant of the enclosed cabin. For such a gunner or observer, Major E. L. Hoffman of Wright Field has developed two devices of real utility. A series of photographs show the operation of these two devices.

Using the quick-attachable parachute holding device. The airman is ready to jump after placing the fittings together and giving the pack a quarter turn

In the upper photograph, the gunner is shown in an open cockpit wearing the "quick-attachable" harness. He is anchored to the floor of the plane by the "monkey-tail" safety strap, which allows him perfect freedom of motion. The "quick-attachable pack" is shown fastened to the side of the cockpit. Other photographs show a close up of the harness; an airman preparing to jump, who has grasped the pack and is about to attach it to the harness; fitting the pack into the harness and giving it a

The observer or gunner may stand when held by the "monkey tail"

quarter turn to lock it securely into place; and the airman all set for his jump.

The flier can quickly release himself from the "monkey tail" by simply pressing on a collar.—*A. K.*

Will Flying Invalidate a Life Insurance Policy?

NOW that flying is becoming more and more a matter of course, the head of a family is apt to inquire as to the effect flying will have on his life insurance policy. Barber & Baldwin, aviation underwriting agents, have recently conducted an investigation in this regard, and announced that for old life insurance policies at present in existence, flying does not invalidate the contract—but if a provision exists for double indemnity in case of death by accident, the double indemnity will not be paid if the accident is a flying one.

In new policies "occasional flying" is permitted. The term "occasional flying" is variously defined by different companies. Thus the number of flights a year permitted when a new policy is granted is set at two by one company; three by two companies; five by four companies and so on until we find that 12 flights a year are considered "occasional" by seven of the 45 insurance companies to whom a questionnaire was sent. Though this is quite reassuring, persons taking out new life insurance policies are advised to look into this particular point if they intend to use the ever spreading net-work of passenger airlines.—*A. K.*

Nitrogen is Abundant

NITROGEN, which enters into the composition of so many useful products, constitutes four fifths by volume of the earth's atmosphere, according to a report by Bertrand L. Johnson, of the United

Kellett Autogiro with side-by-side seating, high rotor, and large fixed wing

States Bureau of Mines. Estimates made by various authorities as to the total amount of nitrogen in the air go far toward dispelling any possible fear of a shortage of this element. One scientist states that the earth's atmosphere contains 4,000,000,000,000,000 tons of nitrogen, while another declares that the air over each square mile of the earth's surface carries 20,000,000 tons of nitrogen, a quantity sufficient to last the world for about 10 years at the present rate of consumption. When the 196,950,000 square miles of the globe are considered, the magnitude of this enormous supply can be appreciated.

As nitrogen is slightly soluble in water, it is found dissolved in sea water, river water, rain water, and mineral waters. It also occurs in gases of volcanic origin, in gases from springs and geysers, in gases from inclusions in certain rocks, and in the occluded gases of meteoric iron. It is reported in small quantities in a variety of rocks and minerals. All living matter contains combined nitrogen, which is a necessary constituent for the growth of living organisms. Fossil organic matter, preserved in beds of coal and oil shale, is likewise nitrogenous. Ammonia and ammonium compounds occur in the soil as a result of the bacterial decomposition of nitrogenous vegetable and animal matter. Ammonia is also present in the air, and some volcanic waters contain ammonium compounds.

Electrical discharges in the atmosphere cause the formation of oxides of nitrogen. These oxides dissolve in rain to form nitrous and nitric acids which are carried down to the earth's surface and washed into the soil. It has been estimated that lightning results in the fixation of 100,000,000 tons of atmospheric nitrogen annually.—*A. E. B.*

The Kellett Autogiro

THE Autogiro is now licensed for manufacture in the United States to three or four firms, and it is believed that others are also applying for licenses. This means that there will be competition in the Autogiro field, and the evolution of the type is therefore likely to be more rapid than were its development concentrated within a single group of engineers and constructors. The latest model to be built is the Kellett K-2, which, while designed on orthodox Autogiro lines, brings several new ideas to the fore.

It is claimed that the Autogiro is *par excellence* the craft for the private owner. Since, in private flying, the ability to be sociable is an asset, side-by-side seating has been adopted in the K-2 for the first time in an Autogiro.

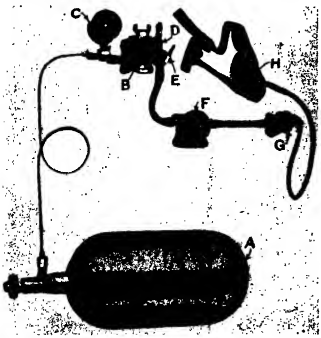
In previous designs, the criticism has been made that the rotor was placed too low in relation to the cockpit, making parachute jumping difficult, and giving some uneasiness to the occupants. In the K-2 the rotor is placed unusually high.

The fixed wing has been made very much larger than before in proportion to the size of the rotor. The Kellett Company announces a top speed of 100 miles per hour, and some of this extra speed may be attributed to the use of a large fixed wing. The rotor is a splendid medium of high lift and for slow descent, but it is not nearly as efficient as a fixed wing in normal flying. By using a large fixed wing, more of the load is transferred from the rotor to the fixed wing at high speeds. Since the fixed wing is then more efficient, better performance is the result.—*A. K.*

Comfort at High Altitude

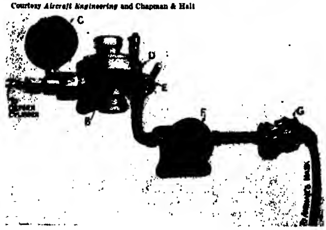
THE record for altitude flight was held until quite recently by Lt. Soucek, U. S. N., who on June 4, 1930, in a Chance Vought Apache airplane flew to a height of 43,166 feet. The record still stands as far as airplanes go, though Professor Piccard in his "stratosphere" balloon is said to have mounted to a height of 50,000 feet. Professor Piccard himself made some very optimistic statements regarding "stratosphere" flying. The Junkers Company of Germany is actively preparing a plane for flight across the Atlantic at great altitude and at enormous speed.

To a limited extent the argument that flight at very high altitudes may be exceedingly rapid is justified, but there are many difficulties for the personnel in high altitude flying. The Junkers Company proposes an airtight cabin, with air at sea-level pressure to be supplied by a compressor. Electric heating of the cabin will no doubt be resorted to. Little reliable detail has reached us yet, but our interest in the flights of Army airmen at tremendous heights always increases as we read of the possible commercial uses of altitude flying. An article by Major C. J. Stewart in *Aircraft Engineering*, entitled "High Altitude Flying" is therefore most timely.



The oxygen apparatus for fliers at high altitudes. At the left is the complete equipment, and at the right below is a close-up of the controls. The text describes lettered parts

Courtesy *Aircraft Engineering* and Chapman & Hall



How does it feel to be up 40,000 feet, in a temperature of 90 degrees, Fahrenheit, below freezing?

Tissandier, giving an account of his famous balloon ascent of 1875, (in which his two companions perished)—gave an illuminating statement:

"At 24,600 feet the condition of torpor which comes over one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. On the contrary one feels an inward joy. There is no thought of the dangerous position; one rises and is glad to be rising."

Even at 15,000 feet the pilot's judgment and perception are apt to be dulled, while at the same time he is likely to feel the exaltation of a man who has imbibed somewhat too freely.

It is not the drop in pressure which is to blame, although the low pressure does produce discomfort. The gases in the air spaces of the nose and the eustachian tubes leading from the throat to the middle ear do indeed distend (the orifices of these tubes are too small to permit equalization of pressure with the surrounding atmosphere) and many airmen complain of discomfort in the frontal sinuses. But this discomfort is not important or dangerous. What is dangerous is that, with decreasing pressure, the blood is insufficiently oxygenated, and the whole bodily mechanism is put out of gear. Even in the ordinary atmosphere, sedentary man does not oxygenate his blood properly.

Since these effects of poor oxygenation appear even at a low altitude, and since they are not appreciated by the pilot, the proper thing is to feed oxygen from the very start of an altitude flight.

The requirements of the oxygen apparatus are most exacting. The smallest quantity per minute must be supplied at ground level, and this quantity must be automatically increased as altitude is gained. There must never be excess supply. Vibration and intense cold, down to 60 degrees below zero, Centigrade, must not affect the apparatus; there must be no leaks; the delivery to the mask must be such that no freezing of moisture or saliva can block the supply pipe; and finally a flow-meter must be provided so that the pilot is immediately warned of a restriction in supply. The most frequently used form of oxygen apparatus is illustrated in our photographs.

The oxygen, compressed to 1800 pounds per square inch and carried in the light steel cylinder, A, is led through a pressure gage, C, to the regulator or reducing valve, B, and then to a control valve, D. From there it passes to a flow-meter, F, graduated in thousands of feet. From the flow-meter, the gas passes to a bayonet-union, G, which permits the flexible pipe leading to the mask, H, to be readily connected or disconnected.

Space will not permit us to deal fully with the self-clearing reducing valve, the automatic regulator, and the other ingenious parts of this apparatus. Though they are simple in principle, they are worked out with exceeding care.

Besides a sufficient oxygen supply, there are many other precautions to be taken. Cockpit heating has not yet been satisfactorily achieved. Therefore the airman has to wear a complete suit, carefully padded with kapok, and having padded

rubber-soled flying boots permanently attached to the legs. Electric heating elements consisting of steel wire wound in close spirals are sewed inside the lining of the body, arms, legs, gloves, and feet, and a socket is attached to the breast of the suit to take a lead to the heated goggles. The glasses of the goggles are set in metal frames inside a fur-lined mask. Without these precautions, frosting of the goggles is inevitable.

Cockpit heating is being actively experimented with by the British. Special training and testing chambers simulating high-altitude conditi

refinements man will go in order to extend his conquest of his ·ather, to extend the confines of his environment.—*A. K.*

Aid to Tuberculosis Study

THE ... and expensive biochemical product, asparagin, formerly obtainable only by importation from Europe, can now be produced in the United States on a commercial basis, according to an announce- t by the Department of Agri M. Dorset, chief of the Biochemic Division of the Bureau of Animal Industry, reports the successful production of asparagin in the division's laboratory and the receipt of a shipment of the chemical as produced by the first firm to undertake its manufacture commercially.

The product is classed as an amino acid. It contains the elements nitrogen, hydrogen, carbon, and oxygen combined in a complex chemical group.—*A. E. B.*

Mechanical Chemist Analyzes Flue Gas

A ROBOT named Ranarex which uses no test-tubes and no chemistry, does the work of a chemist and does it quicker and better than could a human being. Ranarex analyzes flue gas for carbon dioxide, reporting constantly to the fireman just how efficiently he is operating his boiler.

The Ranarex principle is based on the fact that the specific weight of flue gas increases in proportion to its carbon dioxide content, carbon dioxide being about 50 percent heavier than the other constituents of flue gas. The instrument contains two chambers, the upper an air chamber and the lower a gas chamber. Gas to be analyzed passes continually through the gas chamber. A motor-driven impeller rotates at one end of the gas chamber, imparting a whirling motion to the gas, which transmits a turning motion to an impulse wheel at the other end of the gas cham-

Indicating and recording meters of the equipment which determines the percentage of CO_2 in flue gas

ber. The extent of this imparted rotation is proportional to the percentege of carbon dioxide in the gas.

Exactly the same thing happens in the air chamber, except that it contains air instead of flue gas, and the impeller is driven in the opposite direction. The two impulse wheels therefore tend to rotate in opposite directions, but they cannot rotate because they are coupled together by means of two levers and a connection link. This coupling system prevents complete rotation of the impulse wheels, but the difference in the two opposing torques causes a limited movement of the system which is transmitted to a pointer which travels over a scale calibrated in terms of CO_2 content of the flue gas. At the same time a clear continuous record of the results is made on a circular 24-hour chart eight inches in diameter.

The use of the air chamber eliminates the influence of changes in impeller speed, temperature, humidity, and atmospheric pressure.—*A. E. B.*

Sex Hormone Gives Promise

FOUR active substances, probably hormones, have been isolated from the placenta, part of the female reproductive organs, Dr. J. B. Collip of McGill University and one of the famous Toronto group that gave insulin to the world, has reported to the Association for the Study of Internal Secretion. These substances act as sexual stimulants in both males and females. One of them is valuable in treating disturbances of the reproductive cycle in females. It is the first preparation of this type which is effective when given by mouth.—*Scien Service.*

Titanotheres

THE first life-size restoration of gigantic titanotheres—prehistoric animals resembling rhinoceroses, but as tall and bulky as elephants—has just been placed on exhibition at the Field Museum of Natural Hist

The group, a gift from Ernest R. Graham, is the work of the noted sculptor, Frederick A. Blaschke, of Cold Spring-on-Hudson, New York. A background reproducing the natural habitat of these huge beasts has been provided, this being the work of Charles A. Corwin, staff artist of the museum.

The titanotheres were great two-horned beasts which were abundant in the bad lands of Nebraska and the Dakotas about

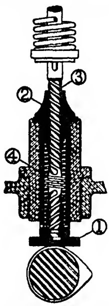
Ranarex, the apparatus which analyzes flue gas for carbon dioxide

30,000,000 years ago, according to the estimates of scientists. The animals, as restored in the museum's exhibit, are modeled to show them as studies of fossil skeletons indicate they must have appeared in life.

The titanotheres lived in wet, marshy lands and fed upon plants, according to Professor Elmer S. Riggs of the Field Museum. Their two horns were placed side by side on the nose. They were related on the one hand to the horse family, and on the other to the rhinoceroses, but they differed from both of these families in many ways.

Automatic Valve Tappet

EVER since the advent of the automobile, engineers have worked incessantly on the problem of perfecting a valve tappet that needs no adjustment, that will



Composed of only four parts, the new valve tappet described in the column below is very simple, exact, and fully automatic in operation

be automatic in operation. The first success in this direction has been attained by R. H. Hamilton, of Christchurch, New Zealand. His valve tappet is shown in an accompanying illustration.

It consists of a tappet body, 1, with a quick female right-hand thread at the base and a female taper at the head; a tappet spindle locking nut, 2, with quick female left-hand thread and male taper to engage with that of 1; a tappet spindle, 3, with right and left hand threads to engage with those of 1 and 2; and a torque spring, 4, with light torsion action between 1 and 2.

During the period when the valve is seated, there is a slight clearance between tapers allowing the torque spring, 4, to maintain the spindle, 3, in contact with the valve stem, forcing the body, 1, on the camshaft and the locking nut, 2, on the guide. The spindle, 3, is supported by the torsional stress applied to the opposed threads. The cam lifting the tappet body, 1, interlocks the tapers by its normal action. On the downward stroke, simultaneously with the seating of the valve, the flange of the locking nut, 2, strikes the top of the guide, allowing the tappet body, 1, and spring, 4, to unlock the tapers.

While designed primarily for automobiles, this new tappet may be adapted to

Courtesy University of Michigan

The complicated Immel apparatus for registering the muscular movements in speech which is being used in researches to determine the cause of stammering

a wide variety of industries where cams are in use and it is necessary, in present practice, to keep them in adjustment manually.

Enzyme Clarifies Cider

AN enzyme decomposing soluble pectin is proposed as an agent for assisting in the clarification of apple cider, by Z. I. Kertesz in the New York State Agricultural Experiment Station Bulletin No. 589. This enzyme acts on pectin and produces no changes in starches or proteins.

During the decomposition of the pectin of the apple juice by the enzyme, some insoluble materials are formed. These insoluble substances, together with other sub- esponsible for the cloudiness of cider, are easily removed by filtration or centrifugation, leaving a crystal clear product which may be pasteurized and bottled within 24 hours after pressing the cider. The product is very palatable and possesses no cooked taste.—*A. E. B.*

New Apparatus for Stammer Study

PROBABLY never in the history of the world has a given spoken sound been uttered twice exactly alike. This very great variation in the spoken word has been indicated by a new apparatus devised to detect and record the muscular action in speech, and which it is hoped will reveal the true nature of the muscular "tangles" which cause the stutterer to hesitate before getting out certain sounds.

This new technique for the study of normal and abnormal speech was developed in the psychological laboratories of the University of Michigan by Dr. Ray K. Immel, Dean of the School of Speech in the University of Southern California.

"Most stuttering is functional and not organic; that is, the organs of speech are intact, but do not act properly," says Dean Immel. Every sound uttered involves an adjustment of lips, tongue, and throat muscles which must be correct before the air can be allowed to pass up through the throat and mouth; if some of the muscles are out of time with the rest, or air is expelled too soon, stammering ensues.

The Immel apparatus attempts to study the external manifestations of this inner movement by means of tambours which attach to the lips, over the "Adam's apple," and below the tongue. Each movement changes the air pressure in the tubes running from the skin to a small drum-head arrangement, to which is attached a delicate pen which makes a record on a roll of smoked paper.

So far Dean Immel has registered the speech of normal persons only, but even here he finds great variations. Not only do different persons manipulate their muscles differently to make the same sound, but they may even use different muscles. Variations in manipulation as great as 100 percent in some sounds are possible, with the result still being understandable.

Most surprising is the discovery that while the mouth is actually uttering one sound, other muscles of the throat and mouth are getting ready to form the next sound, so that speech is a continuous, interlocking physical and mental process. In uttering the sound "k," for example, the preparatory adjustments are going on during 51 percent of the time that the preceding vowel is being sounded.

Although the timing of the speech muscles may have wide variation and still sound normal to the ear, there are limits beyond which faulty co-operation of the muscles results in unintelligible sounds; or one muscle or set of muscles may inhibit the action of another with the result that no sound at all is uttered, a common occurrence with stammerers. By study of thousands of normal variations, Dean Immel hopes to set up pictures of normal muscle behavior, and then by comparing the records of stammerers with these, to find what error in co-ordination is responsible for various degrees and types of stuttering.

Synthetic Wax Mixes with Water

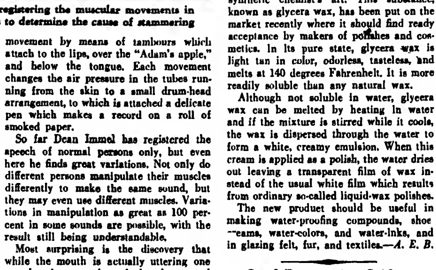
A WAX that can be mixed with water is the latest curious product of the synthetic chemist's art. This substance, known as glycera wax, has been put on the market recently where it should find ready acceptance by makers of polishes and cosmetics. In its pure state, glycera wax is light tan in color, odorless, tasteless, and melts at 140 degrees Fahrenheit. It is more readily soluble than any natural wax.

Although not soluble in water, glycera wax can be melted by heating in water and if the mixture is stirred while it cools, the wax is dispersed through the water to form a white, creamy emulsion. When this cream is applied as a polish, the water dries out leaving a transparent film of wax instead of the usual white film which results from ordinary so-called liquid-wax polishes.

The new product should be useful in making water-proofing compounds, shoe —eams, water-colors, and water-inks, and in glazing felt, fur, and textiles.—*A. E. B.*

Lead Preparation Said to Prevent Rust

APPARENTLY authentic reports from London bring news of a new form of liquefied or colloidal lead, which, it is claimed, when applied to iron and steel, makes these metals permanently impervious



In several large cities, the Baltimore and Ohio Railroad uses this equipment to pre-cool sleeping cars for night runs. A large fan in the motor car draws outside air across cakes of ice, also in the motor car, and discharges the iced air through a window into the sleeping car. Warm air passes out overhead

to rust. The substance, to which the name "Nust" has been given, is being manufactured by the Non-Rust Liquid Lead Co., Ltd., London, at their Bristol factory.

A Swiss scientist, it appears, some seven years ago, after long experiment in smelting lead with other metals, succeeded in producing it in a form equivalent to molten lead, and in preserving it in that state by the aid of oils as conveyors. From the description given, the lead appears to be reduced to an extremely fine powder or dust; mixed with oil this becomes a stiff paint that can be applied with a brush. The claim is that the lead penetrates the iron and steel, and becomes so completely amalgamated with it that it can only be

A new flashlight which, in compact form, combines the features of a more bulky one. It is equipped with a three-way switch; permanently on or off and flashing. The milled ring on its face is for focusing. Standard batteries are used

separated by some metal separation process, while the oils merely dry off and disappear.

Another advantage claimed is that while ordinary paint will not stand the stretching of the steel or iron by more than .05 percent without scaling or cracking, this substance has successfully stood a stretching test of 1 percent. "Nust" is applied thinly, exactly as an ordinary paint.

Possibly the preparation may have other applications, but experiments so far have been limited to iron and steel.—*A. E. B.*

Further Honor

IN our July number comment was made concerning the unusual honor recently paid to Dr. R. W. Wood, Professor of Experimental Physics at the Johns Hopkins University, by the University of Berlin. *Nature*, the leading journal of science in Great Britain, now makes the following comment on the same honor, ranking Professor Wood's researches with those of Michelson:

"The philosophical faculty of the University of Berlin has conferred upon Professor R. W. Wood, of the Johns Hopkins University, Baltimore, the degree of Doctor of Philosophy (*honoris causa*). This is the highest honor which the faculty has in its power to give, and is a recognition of Professor Wood's contributions to physical optics.

"In announcing the award, Professor

(*Please turn to page* 205)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

"AND now out of the wilds of Burma come several photographs of the little telescope made from the plans of Porter and which is giving me many moments of pleasure."

Thus does A. B. Stephens open a letter from Negya, Chauk, Burma, where

Drilling away in Burma—Stephens

he has been drilling oil wells. He continues:

"The glass is of six-inch aperture and was furnished by John Pierce of Vermont, along with the prism and eyepiece. Grinding and polishing the glass required several months, working a few minutes each day, and the figuring took another long period of time as I overshot the mark while parabolizing it and got a nice deep hole in its center. After the hole was finally removed, a comparatively short time was necessary to bring the surface to a good figure. My greatest trouble was in finding a lap to stand up in this warm climate but finally one made of tar and rosin served very well. The silvering was a complete success the first time.

"Let all those who are eager to make mirrors but do not have the ideal conditions as set forth by Ellison, take heart for, as one of the photographs shows, all of the grinding and polishing of this little mirror was done on the veranda of my bungalow, with, of course, all of the shutters closed. While the glass, no doubt, falls far short of the standard of Ellison and Porter, yet it gives a wonderful view of the heavenly bodies. Not only are the rings of Saturn sharply defined but also several of its moons; two in particular, perhaps Hyperion and Titan, with momentary pin-point flashes of two of the closer moons.

"I leave here shortly and thereafter my address will be 816 East Mayne Street, Bellflower, California."

ALL over the world, in the most out-of-the-way places, in homes, on library tables and in the reading rooms of clubs

Burman boys and (right) a teacher

you will find the SCIENTIFIC AMERICAN. Here is a letter which reached us from New Zealand, written by Robert Bruce of 33 Vincent Street, Auckland:

"I have read with interest of the many ingenious astronomical telescopes made by amateurs. The humble efforts of a grocer might interest your readers. I enclose a photograph of my three-inch home-made refracting telescope. Having a 3½-inch Drummond lathe I may have an advantage over some amateurs. The telescope and equatorial mountings are in brass and gun-metal throughout, except the declination axis, telescope cradle, and R. A. axis, which are of mild steel. As the photograph shows, the polar axis is adjustable to all latitudes. There are slow motions in R. A. and declination. The R. A. circle is divided into 11/12-degree divisions and declination circle likewise. The R. A. circle is a rebated ring which for adjustment rotates on a central rebated disk which is firmly clamped to the polar axis. The circle is read by one fixed vernier and one movable one.

"To adjust telescope to R. A. of star, first place it in the meridian position, rotate R. A. ring till desired R. A. is read off fixed vernier, then clamp ring to disk and move telescope till correct sidereal

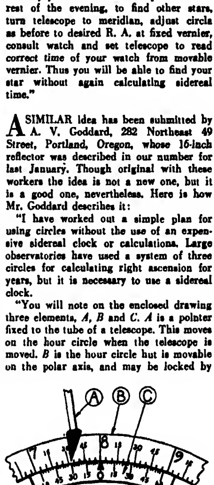
Made in New Zealand by Robert Bruce

time is read by the same vernier, and there you are. Then, while the star is still in the field, put movable vernier to correct time by your watch and clamp it. For the rest of the evening, to find other stars, turn telescope to meridian, adjust circle as before to desired R. A. at fixed vernier, consult watch and set telescope to read correct time of your watch from movable vernier. Thus you will be able to find your star without again calculating sidereal time."

A SIMILAR idea has been submitted by A. V. Goddard, 282 Northeast 49 Street, Portland, Oregon, whose 16-inch reflector was described in our number for last January. Though original with these workers the idea is not a new one, but it is a good one, nevertheless. Here is how Mr. Goddard describes it:

"I have worked out a simple plan for using circles without the use of an expensive sidereal clock or calculations. Large observatories have used a system of three circles for calculating right ascension for years, but it is necessary to use a sidereal clock.

"You will note on the enclosed drawing three elements, *A*, *B* and *C*. *A* is a pointer fixed to the tube of a telescope. This moves on the hour circle when the telescope is moved. *B* is the hour circle but is movable on the polar axis, and may be locked by



Goddard's convenient wrinkle

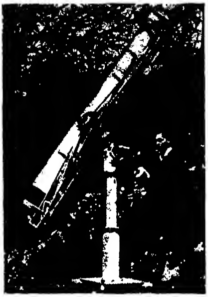
means of a thumb-screw. *C* is an ordinary vernier with zero point, fastened permanently to the mounting of the telescope. This is all the equipment necessary, except for an ordinary cheap alarm clock or a watch that will keep fair time for a few hours and can easily be set.

"Here is the procedure: Look for any first magnitude star or object with a known right ascension. One near the zenith is best as this avoids refraction. Take Regulus, for example, at R. A. 10 h 4 m. Loosen the thumb-screw on the hour circle *B*, and revolve the circle on the polar axis until the pointer *A* indicates 10 h 4 m. Now lock the circle with thumb-screw. Line up the crosshairs in your finder exactly on Regulus and set your clock for the exact time indicated on your vernier *C* and the hour circle *B*. The clock will now take care of all difference in time for the remainder of the night. Now that the clock is set, it is a simple matter to find anything you like.

"This may sound complicated but if once

tried you will be surprised at the simplicity. The drawing indicates 8 o'clock as shown on your clock. The pointer *A* may be placed in any convenient position relative to the tube, as long as the R. A. circle *B* can be revolved under it. I have used this system for a long time and find it very satisfactory."

HERR SASCHA CHAGUN sends ... ie ... l, ... e, ... r



This one was "made in Germany"

book 'Amateur Telescope Making.' The mirror has a diameter of 24 centimeters and a focal length of 2.2 meters. It was polished on a paper lap, using tripoli. In as much as this method of polishing is simpler and safer than the wet process (the polish is never as perfect which, however, does not decrease the optical efficiency) I am surprised that you did not mention this method in your book. Maybe you will consider it in a later edition. I think your book is excellent and I hope it will enjoy the widest dissemination."

We cannot agree with Herr Chagun about the paper polisher or about the optical efficiency. Also, we did mention this matter in the instruction book "Amateur Telescope Making." On page 255 Professor Elihu Thomson correctly says, concerning the paper polisher, "It cannot be expected to yield the high accuracy that may be obtained with pitch." Bell, in "The Telescope," page 71, says, "Cheap lenses are commonly worked on a cloth polisher . . . or sometimes on paper worked dry. With care either may produce a fairly good surface, with, however, a tendency to polish out the minute hollows left by grinding rather than to cut a true surface clear down to their bottoms. All first class objectives and mirrors are in fact polished on optician's pitch." For years Dr. Woolsey Blacklock of England has been using and urging the use of the paper polisher, his letters in *English Mechanics* being answered chiefly by Ellison who takes the position that this kind of lap is distinctly inferior to the pitch lap, mainly because it permits of no accurate contacting and lacks the "spring" and life of pitch. We vote for pitch or HCF.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

To make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

BODILY POSITIONS IN RESTFUL SLEEP by H. M. Johnson, Ph D., describes intensive studies carried on at the Mellon Institute for a period of six years. Some of the apparatus used is of great interest. *The Simmons Company, 230 Park Ave., New York City.—Gratis.*

FARM WATER POWER (Bulletin 1658-F, U. S. Department of Agriculture) describes a number of successful plants, and gives costs. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

WHITE GOLD—THE STORY OF THE HOOVER DAM is an epic story of a great national achievement told a popular way. It is charmingly illustrated. *American Steel & Wire Company, 208 South La Salle Street, Chicago, Illinois.—Gratis.*

STRAIGHT LINE CONTINUOUS ELECTRIC FURNACES deals with the uniform heat treatment of ferrous as well as non-ferrous strip metal and wire. The accurate performance of razor blades, sawblades, surgical knives, et cetera can be expected only if they are prevented from oxidation while being heat treated. *H. O. Swoboda, Inc., 3400 Forbes Street, Pittsburgh, Pa.—Gratis.*

AN EXPLANATION OF AMERICAN LUMBER STANDARDS (Miscellaneous Publication No. 107, U. S. Department of Agriculture) by C. V. Sweet gives grading rules as adopted by the various soft wood lumber manufacturers' associations of the United States. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

ECONOMIC ASPECTS OF LAND SETTLEMENTS IN THE CUT-OVER REGION OF THE GREAT LAKE STATES (Circular No. 160, U. S. Department of Agriculture) by W. A. Hartman and J. D. Black describes the fundamental conditions affecting the development of this cut-over region and summarizes briefly the possibilities and opportunities for agricultural development. *Superintendent of Documents, Washington, D. C.—20 cents (coins or money order).*

SURVEY OF LAND-GRANT COLLEGES AND UNIVERSITIES (Office of Education Bulletin, 1930, No. 9, United States Department of the Interior) is a two volume work aggregating 1919 pages. It was directed by Arthur J. Klein. Readers who are interested only in certain phases of the subject such as "student relations and welfare"; "home education," "alumni and farmer students," and so on, can obtain the 21 parts separately at prices running from 10 to 25 cents. A list of the parts and the prices can be obtained from the Office of Education, Washington, D. C., free, or the two volumes can be secured of the *Superintendent of Documents, Washington, D. C., for $1.50 each (money order).*

SERVICE MANUAL FOR ARTIC, ARTIC N, METHYL CHLORIDE A, AND METHYL CHLORIDE AN, gives a brief summary of the physical and chemical properties of Artic and the new Artic mixtures. The servicing and installation of refrigeration units using the refrigerant Artic brings up general problems in the use and handling of this product which are discussed in the manual. *The Roessler & Hasslacher Chemical Company, 350 Fifth Avenue, New York City.—Gratis.*

STANDARD TIME ZONES OF THE UNITED STATES AND ADJACENT PARTS OF CANADA AND MEXICO (Miscellaneous Publications No. 111—National Bureau of Standards) is a large map showing the time zones in red. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

HOW TO MAKE ENLARGEMENTS (Practical Photography No. 5) by Frank R. Fraprie and Arthur Hammond has stood the test of time, 34,000 copies having been printed. *American Photographic Publishing Company, Boston, Mass.—40 cents.*

BALL AND ROLLER BEARINGS is a handbook for designers and engineers. The diagrams, printed like blue prints, give a wealth of valuable information when used in connection with the tables. *Aetna Ball Bearing Manufacturing Company, Chicago, Illinois.—Gratis.*

NEW AIRWAY BULLETINS DESCRIBING RADIO FACILITIES will be sent on request by the *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

WILD GAME—ITS LEGAL STATUS attempts to answer such questions as "who owns game?" "Under what conditions?" It is a reprint of a report made to the Massachusetts Game and Fish Association by its attorney. The text defines game and traces the story of its ownership through the ages to the present day. *Smokeless Powder Division, E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

GENERAL ELECTRIC PHANOTRON TUBES gives technical information relative to Phanotron and Thyratron tubes. The name "Phanotron" is the General Electric trade name for a gas or vapor content vacuum tube. *General Electric Company, Schenectady, New York.—Gratis.*

USE OF BISMUTH IN FUSIBLE ALLOYS (Circular of the Bureau of Standards No. 388) describes one of the essential constituents of the readily fusible alloys. The literature and uses of fusible alloys are reviewed in this paper. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

PATENTS AND RESEARCH by Joseph Rossman, Ph. D. describes the relation between industrial research and invention. Patent protection is without doubt one of the greatest incentives in the development of an art. *Dr. Joseph Rossman, United States Patent Office, Washington, D. C.—Gratis.*

FORMULAE FOR FLAVORS, SYRUPS, EMULSIONS, JELLY, JAMS, ETC. are given in a leaflet which also deals with meringue and marshmallow preparations, also foam and froth producers. These are new and up-to-date formulas, which if carefully followed, will give uniformly good results. *Glyco Products Company, Inc., Bush Terminal Building, No. 5, Brooklyn, N. Y.—Gratis.*

AN UP-TO-DATE LIST OF THE SHORT-WAVE BROADCASTING STATIONS OF THE WORLD is probably the most recent and accurate compilation of its kind. *Pilot Radio and Tube Corporation, Lawrence, Mass.—Gratis.*

DUBILIER CATALOGUE is an interesting piece of literature covering condensers, transformers, and other radio equipment. *Dubilier Condenser Corporation, 4377 Bronx Boulevard, New York City.—Gratis.*

FLOW OF LIQUIDS IN PIPES OF CIRCULAR AND ANNULAR CROSS SECTION (Bulletin No. 222) by Alonzo P. Kratz, Horace J. Macintire, and Richard E. Gould gives a report on the continuation of the work the results of which were published in the same series of bulletins, No. 182. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—Each bulletin 15 cents.*

THE USE OF LOGS AND POLES IN FARM CONSTRUCTION (Farmer's Bulletin No. 1660, United States Department of Agriculture) by T. A. H. Miller shows how logs and poles can be employed advantageously in the building of dwellings and farm conveniences by settlers or others establishing themselves in regions where timber is plentiful. There are 31 illustrations. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 201)

Jaeger, the dean of the faculty, singled out as of particular importance Professor Wood's researches on the resonance radiation of gases and vapors. These have certainly called for the exercise of the utmost experimental skill, and although initially conceived and carried out at a time when our knowledge of the structure of atoms and molecules was practically nothing by current standards, have contributed in no small degree, and continue to contribute, to our present ideas on 'the exact nature of the piece of machinery which we call the molecule,' to use Professor Wood's own words.

"With the study of resonance radiation, however, one is tempted to associate Professor Wood's allied work on magneto-optics, and to quote as an example of his ingenuity the separation of the *D* lines of sodium for work with intense beams of monochromatic light by the difference in their rotations.

"More recently, Professor Wood has been interested in the Raman effect, where he has devised methods for reducing the time of exposure needed for recording the feeble spectra of modified radiation, and has also developed rapid methods for measuring up the Raman spectra.

"In addition to his many experimental contributions to physical optics, Professor Wood is the author of two books on the subject, and has ruled gratings for other laboratories. His work, although naturally carried out on rather different lines, is in every sense worthy of being ranked with that of Rowland and of Michelson."

Professor Wood is also a contributing editor of the SCIENTIFIC AMERICAN. Readers will recall his article, "Sounds that Burn," on the super-sonic wave, in the number for March, 1928, and his article on the Raman Effect, in the December, 1930, number.

Warns Against Diabetes Nostrums

"PERSONS suffering from diabetes should not rely on the curative claims made by manufacturers of worthless nostrums, since there is no drug or combination of drugs known to medical science which can cure this disease," said Dr. J. J. . of drug control, Federal Food and Drug Adm n, recently, in . ing upon a government seizure of a product, Insurol, shipped by the Deutsche Vital Gesellschaft, Berlin, Germany, to a New York concern. "The only safe and reliable treatment for this disease is the continued hypodermic injection of insulin together with a suitable diet, and this is not to be considered a cure. Insulin is now recognized by medical men in the leading nations of the world as being an effective treatment, when used in conjunction with a regulated diet, but not as a cure for the disease. At the same time, every country has its favorite herb, superstitiously believed to have curative value for diabetes. None of these herbs has cured the disease."

Analysis by Federal chemists and pharmacologists showed that the preparation Insurol contained no ingredient or combina-

tion of ingredients capable of producing the effects claimed upon the label, and thus became liable to seizure under the Federal Food and Drugs Act, which has jurisdiction over imported goods as well as those entering into interstate traffic in the United States. The pills consisted largely of some clay-like material, yeast, reducing sugar, a dried glandular substance, and smaller amounts of other material.

Sun Operates Dead Sea Potash Plant

ONE of the most picturesque modern chemical industries in the world is located on the Dead Sea in ancient Palestine, where a plant for extracting potash salts from the sea by solar evaporation was recently put in operation.

The plant involved in the production of potash and other products by this method includes large, open, shallow pans, erected on the land bordering the sea, in which the water from the sea is rapidly evaporated through exposure to the influence of hot sun rays and winds; pumps for pumping the water from the sea into the various pans; plant for collecting or harvesting the precipitated salts and transporting them to the refinery; pumps and pipe lines for fresh water supply from the Jordan for the needs of the refinery, for cooling the engines, and for general purposes of the undertaking; potash factory or refinery for working up the crude salts into the final product for marketing; bromine plant for extracting the bromine concentrated in the final brine and preparing it for marketing; and a power station.

The main part of the orders for machinery and apparatus was placed in England in January, 1930. On April 1 the operation of pumping the water from the Dead Sea into the pans started, using one large pump. These operations were considerably increased two months later by the of two more pumps. With the arrival of engines, pipes, and c chinery at the Dead Sea, the erection of other plants—fresh water supply, power house, and workshops—was taken in hand, and the greater part completed by the end of July. By that time a pan area of about 120 acres was filled with rapidly evaporating sea water and the precipitation of large quantities of common salt forming layers a few inches thick in the pans was already in progress.

Soon after the greater part of the common salt had separated out, the precipitation of crude potash salt (carnallite) began, and by the end of August a few thousand tons formed loose layers in the lower evaporating pans designated for this purpose. The collection and harvesting of this salt into piles was in progress at the beginning of October and proceeded up to the end of December. A certain amount of common salt of good quality was also collected into piles. The operations of the first working season were thus completed, having fully confirmed the results obtained by the experimental work of the preceding years, and proved the possibility of manufacturing the potash from the waters of the Dead Sea by applying the sun's rays as heat for evaporating and precipitating the chemical salts.

In view of the satisfactory results of the first year's operations (when both quality and quantity of the crude potash salts produced, as well as the cost of production, fulfilled expectations) it was decided to increase the plant, to create a unit capable of producing up to the limits of the existing means of transportation from the Dead Sea to one of the Palestine seaports, Jaffa or Haifa.—*A. E. B.*

Easy to Handle the Bee Sting if You Know How

THE sting of the honey bee is painful, but interesting. If the victim understands the structure and operation of the bee's defense weapon, he can prevent much of the pain and swelling. J. I. Hambleton, in charge of the bee culture laboratory of the United States Department of Agriculture, gives this cheering information.

When a bee prods its victim it tears itself from its sting, a sacrifice which costs the insect its life. But the sting left in the

Designed by the U. S. Department of Agriculture to prevent soil er—, this machine uses sets of shovels which alternately operate to dig holes at regular intervals. The machine digs about 10,000 holes per acre. Rain water stays in these holes, two or three gallons in each, and soaks into the ground instead of running off

skin has just started on its way, for it and the poison sacks attached are equipped with muscles which tend to drive it deeper and deeper.

The sting is composed of two lancets, each provided with a series of sharp barbs pointing backward similar to those of a harpoon. The reflex action of the muscles attached to the sting mechanism is such that first one lancet is driven into the flesh, where it anchors, then the other, and so on, each lancet going a little deeper and becoming more firmly lodged. During this time the muscles are also squeezing the poison sacks in such a manner that poison is constantly being pumped into the wound.

Most persons make the mistake of trying to pull out the sting. When this is done the pressure of the fingers empties the poison sack into the flesh. The sting should be immediately scraped or scratched out, and since no time is to be lost looking for a knife or even in opening one, the fingernail is the best thing to use in the emergency, says Mr. Hambleton, who has

frequently made the demonstration before interested visitors at the bee culture laboratory.

Zinc Sulfide Removes Surplus Luster From Rayon

WHILE silk is admired partly for its natural luster, too much of a good thing is bad, as makers of rayon, particularly the cellulose acetate variety, well '. Cellulose trous to look like silk and therefore has to be de-lustered before it is marketed. A new process for the permanent de-lustering of cellulose acetate rayon precipitates within it a small proportion of zinc sulfide; this substance is sufficiently white to allow its use without yellowing the rayon. It is to be noted that the de-lustering thus obtained is much more permanent than that produced by the older process of boiling the rayon in a solution of soap, and at the same time the rayon gains an affinity for cotton dyes. This change in dyeing properties is not due to saponification, since this does not occur, but rather to the fact that the cotton dyes form lakes with the zinc sulfide.

The method adopted consists of treating the rayon with a solution of zinc salt (zinc chloride) and a swelling agent such as acetic acid or acetone, and then passing the rayon without previous rinsing through a solution of sodium sulfide; afterwards the rayon (de-lustered) is washed and soaped. —*A. E. B.*

An all-glass distillation column, designed to bring the cleanliness and convenience of the laboratory to the factory. Tower sections and pipe lines of a size suitable for commercial use have been developed by the Corning Glass Works

Technical Tests Used in Grading Farm Products

MECHANICAL and chemical tests are rapidly replacing human judgment in measuring the quality of farm products. Ten years ago, says the United States Department of Agriculture, only a few such tests were used successfully. To-day many products are tested chemically or mechanically by methods that give to partic quality factors a specific value in c modity standards.

One device recently developed measures the moisture content of grain by recording the resistance offered to an electric current passed through it. This method requires only 30 seconds, as compared with the 40 minutes necessary under the old method.

Technical tests are employed in measuring certain quality factors in fruit. The sugar content of grapes is determined by the saccharimeter. A sugar acid test is used to ascertain t' aturity of citrus fruits. A specific gr test shows the maturity of cantaloupes.

In grading canned fr its and vegetables a pressure gage indicates the vacuum condition of the c . The density of sirups is tested with hy ometers. Salinometers are used in testing brine solutions, and penetrom ters in determining the consistency of su h products as canned pumpkin. Mechani al devices measure the maturity of cann d corn. A fruit pressure tester has been developed to determine the m of plums, apples, and pears. The colorimeter measures color in hay, cotton, and honey, in which products color is an important quality factor.

Cotton fiber lengths are measured with a high degree of accuracy by an improved cotton fiber sorting machine. The strength of cotton fibers may be ascertained by the bundle fiber test.

Some qual odor, are naturally difficult to measure by technical tests, though means for doing so may some day be developed. Research on this problem is under way. The progress already made in the measurement, by technical means, of specific quality factors suggests that dependence on personal judgment or skill, though still necessary to a considerable degree, may eventually be largely eliminated. This elimination will make grading increasingly uniform throughout all seasons and areas.

Nickel-Barium Makes Better Spark Plugs

HOW the mistaken impression that pure nickel was the best material for spark plug points eventually led o the discovery of a barium-nickel alloy which gives a stronger and more regular spark than any before known, is the stor of the roundabout way which science sometimes takes to make her discoveries, according to a report of work done by the University of Michigan Department of Engineering Research.

Years of experience had taught sp k plug makers that nickel wire was the est for spark plug points. One manufact rer, however, thought that tho quality r ght be improved and com O. S. Duffendack and Dr. R. A. Wolfe o the University of Michigan physics depart men to investigate. Assuming that very pur nickel might give better results, the scien tists made tests of this only to find it much poorer than the commercial product. Spectroscopic and microscopic study showed that the nickel contained small portions of magnesium which had originally been added to remove sulfur while the nickel was molten, and which was supposed to have evaporated away entirely before cooling.

When occasional bits of the magnesium

worked to the surface of the sparking points, and just before they evaporated in the heat of the arc, they created an electrical condition which allowed a strong spark to jump the gap much more easily than when no magnesium was present at the tip. Thus, fortunately for plug makers, this portion of magnesium allowed them to make satisfactory spark plugs—almost in spite of themselves.

Despite its value, however, magnesium has faults. It does not make a true alloy with nickel, but distributes itself in microscopically small bits haphazard in the metal; enough of it cannot be added to produce the best results; and it evaporates faster than the nickel, thus leaving a tip of nickel only, at which time firing troubles may ensue. Hence the search was started for a substitute which was found in barium.

This metal alloys with nickel very well and so becomes evenly distributed. It may be added in large amounts to nickel and so make possible a strong spark with a relatively low voltage. Compared with pure nickel the barium alloy reduces needed sparking voltage by 50 percent and by an average of 25 percent compared with commercial magnesium-bearing nickel. In the heat of the spark, it evaporates away at the same rate as nickel, insuring a point of regular character and quality, producing a generally long-lived and dependable sparking point. The barium alloy has also proved advantageous as a base metal for oxide cathodes in radio tubes and experiments indicate distinct possibilities for use in electron devices of various kinds.

Electric Hammer Does a Chemist's Job

THE time required to determine accurately the amount of moisture in lumber has been reduced from a week to a few seconds, and no longer is it necessary to spoil a board by cutting analysis blocks from it. Apparatus developed by Dr. C. G. Suits of the General Electric research laboratory and M. E. Dunlap of the United States Forest Products Laboratory at Madison, Wisconsin, makes it possible for a workman to check any or all boards in a consignment speedily and exactly.

A tap with a special hammer, a turn of a dial, a flashing red light or a buzz in earphones—and the analysis is made. With all the equipment contained in a portable metal carrying case, it is easy for the inspector to move around the lumber pile or yard.

It has long been known that the electric resistance of wood changes with its moisture content. With a circuit having two neon glow lamps, the moisture content of wood is now determined by that resistance change. One of the neon lamps is connected across a fixed condenser, so adjusted that when the condenser builds up current to a certain point, the neon tube discharges with its characteristic red flash. This rate of flashing is adjusted to about once per second. The other neon tube and its condenser are in series with the hammer's knife-edged electrodes which are driven into the wood. By means of a variable condenser, the circuits are adjusted so that the two tubes flash simultaneously. Then the dial of the variable condenser shows the percentage of moisture in the lumber. The adjustment can also be made by listening to a buzz in the earphones, a method that has advantages when working in bright sunlight which makes it difficult to see the flashes of the neon tubes.

The hammer with which the lumber is struck is double-faced and of treated wood. Small, knife-shaped, stainless metal electrodes, about one inch apart, project from each face of the hammer. From the instrument case a long, rubber-insulated, water-proof cable passes through the hammer handle to the electrodes. Those on opposite faces of the hammer are at right angles, making it easy for the operator

The knife edges on this "electric hammer" sink into the wood and make possible the test described

to work at the side or at the end of a pile of lumber. Since the electrodes are knife-edged and only slightly penetrate the wood, the lumber is not damaged by the tests.

The instrument reads between 7 and 24 percent moisture content. A lower figure, which can be attained with special kiln-dried lumber, is difficult to hold because of the humidity of the atmosphere, and is not regularly used in lumber analyses; lumber with more than 24 percent moisture is usually too wet for industrial uses. Most lumber with 30 percent moisture has gone beyond the fiber saturation point, so that the moisture is present as water between the wood cells.

The strength and dimensions of wood depend on the moisture content; the lower the moisture, the better the wood. Considerable wood has been sold on moisture content specifications; but so complicated has been the method of determination that adoption of such specifications has not been universal.—*A. E. B.*

Our Production of Copper, Zinc, and Lead in 1930

THE copper industry in 1930 was severely affected by the general worldwide industrial depression. Production and consumption, which made new high records in 1929, dropped sharply, according to the United States Bureau of Mines. Although production and consumption in 1930, both were at a rate far below 1929, the decline in production lagged behind that in consumption, causing a substantial increase in

stocks. Estimated stocks of refined copper at domestic refineries at the end of the year were the largest on record.

The smelter production of copper from domestic ores in 1930, as determined by the Bureau of Mines from reports of the smelters showing actual production for 11 months and estimated production for December, was 1,375,000,000 pounds, compared with 2,003,000,000 pounds in 1929. The 1930 production is 31 percent lower than that of 1929, and is the smallest production recorded since 1922. The production of new refined copper from domestic sources, determined in the same manner as smelter production, was about 1,485,000,000 pounds, compared with 1,983,000,000 pounds in 1929.

Production of primary zinc from domestic and foreign sources, and apparent deliveries for domestic consumption in 1930 were also lower than in any year since 1922. Stocks of metallic zinc at smelters and at electrolytic refineries were nearly doubled during 1930 and at the end of the year they were the highest on record. The output of primary metallic zinc in 1930 was about 499,300 tons. In comparison with 625,447 tons in 1929, the decrease in total primary production for 1930 amounted to 20 percent.

The domestic lead industry was less severely affected by the worldwide industrial depression of 1930 than either the copper or the zinc industry. The output of lead from domestic sources was 15 percent lower than in 1929, while copper and zinc showed decreases of 25 and 20 percent, respectively. The output of primary lead from domestic sources was the smallest recorded since 1924 and that from domestic and foreign sources the smallest since 1923. The output of primary domestic desilverized lead in 1930 was about 324,000 tons; of soft lead about 200,000 tons and of desilverized soft lead about 45,000 tons, making a total output from domestic ores of about 569,000 tons of refined lead. Corresponding figures in 1929 were 381,487 tons of desilverized lead, 235,345 tons of soft lead, and 55,666 tons of desilverized soft lead, making a total of 672,498 tons.

—*A. E. B.*

ASQUITH AND KITCHENER

(*Continued from page* 180)

It must be recorded that he vacillated, inclining first to one front and then to the other, and he gave neither General Hamilton enough men to threaten Constantinople seriously, nor General French reinforcements sufficient to prevent the Germans from reinforcing Ludendorff's army in Poland. The result was Allied failure at the Dardanelles, in France, and in Poland. With the existing German superiority in the Spring of 1915, the Allies were due for a bad year, no matter what course they pursued, but by failing to concentrate their efforts on the Western Front, they turned a difficult situation into a critical one.

In the early days of the war, Asquith held a cabinet meeting almost daily. He has left us in his diary brief but finely drawn sketches of his colleagues as they met around the council table, and his own account of his methods of handling a Cabinet during a great war. He extended Cabinet ministers full authority in their own departments, gave them strong support, listened sympathetically to their woes, forgave their errors, and gave them generous credit for their achievements. When two members clashed, he lent himself fully to finding a means of reconciling their views. Under the pressure of war, wise men frequently differed widely. When a compromise solution acceptable to both members could not be reached, Asquith was apt to postpone decision in the hope that time would reveal the answer; on many occasions postponement effected a compromise but Asquith soon acquired the unenviable reputation of being a "wait and see" man.

He had no fear of being displaced as Prime Minister and disdainfully ignored frequent reports of intrigues against him. He once confronted Lloyd George, his only possible rival, with reports of intrigues, but accepted in full the vehement denials that Lloyd George immediately offered.

In his manner of dealing with his civilian colleagues, even a hostile critic can find few occasions to blame Asquith. He did not come to Haldane's assistance when that devoted Minister, who had created the British General Staff and reformed the War Office, was unjustly struck down, but in the existing public hysteria he could have done Haldane no real service and he might have jeopardized his own position. It was a cruel decision, but probably a wise one, to sacrifice Haldane, and that philosopher preserved a patriotic silence.

IN handling the Admiralty and War Department, Asquith was less fortunate; his long peace-time parliamentary and cabinet experience, his superior intellect, even his large theoretical knowledge of military matters gained by faithful service on the Committee of Imperial Defense did not save him from committing error after error. He permitted Churchill to over-ride Fisher on purely naval questions, such as the disposition and movements of naval forces. He sided with Churchill against Fisher on the Dardanelles Expedition, and then used his immense influence to prevent Fisher from resigning.

In May, 1915, Fisher finally insisted upon his resignation being accepted, and Bonar Law, leader of the Conservatives, on May 17 wrote Asquith: "Lord Lansdowne and I have learnt with dismay that Lord Fisher has resigned . . . we cannot allow the House to adjourn until this fact has been made known and discussed. . . . In our opinion things can not go on as they are, and some change in the Constitution of the Government seems to us inevitable if it is to retain a sufficient measure of public confidence to conduct the war to a successful conclusion. . . ." This suavely drawn note was an ultimatum to Asquith to accept a Coalition Cabinet or a debate in the Commons on the conduct of the war.

Asquith capitulated at once but his party loyalty caused him to deal grudgingly with the Conservatives. He replaced Churchill by Balfour, gave Austen Chamberlain the India Office, made Lord Birkenhead Attorney General, but only allowed Bonar Law, the leader of the opposition, the Colonial Office. This political error led to Asquith's undoing for it threw Bonar Law and the leading Conservatives into the arms of Lloyd George in 1916.

The Unionists aimed their blow at Churchill who, they knew, was over-riding Admiral Fisher, his technical adviser at the Admiralty; but it coincided with Northcliff's attack in the London *Times* on Kitchener for failing to supply the British Army with high-explosive shells, so when Asquith commenced to form the Coalition Cabinet it was intended to drop Kitchener.

But the British public had more confidence in Kitchener than in all his critics and their open hostility to Kitchener's removal secured his place in the Coalition Cabinet. Churchill was not so fortunate, and despite efforts of his friends, he was dismissed from the Admiralty. Kitchener had no suspicion that his place was in jeopardy, and it is doubtful whether he suspected at this time that some of his colleagues, notably Lloyd George and Churchill, had lost confidence in his abilities.

Kitchener revealed his innate sincerity by paying a formal call to Churchill at his downfall when he was abandoned by his other colleagues; Kitchener took this step at a moment when none of Churchill's cabinet colleagues dared lend him any political credit and when Churchill would have driven Kitchener from the Cabinet.

ASQUITH had greater confidence in Kitchener than he did in Fisher; as a member of the Cabinet, Kitchener received the loyal support that Asquith extended in such full measure to his colleagues. And Kitchener repaid Asquith by a supreme loyalty and faith; when the Field Marshal, unaccustomed to discussion, unable to answer the questions hurled at him by Lloyd George and Churchill, took refuge in sullen silence, Asquith could always thaw him out, for with correct instinct Kitchener divined that Asquith was essentially straightforward and dependable. Many harassing days were in store for Kitchener; Lloyd George and Churchill frequently disagreed with him, and their keen minds enabled them to discover any weak points in Kitchener's explanations.

Kitchener was probably at his worst in these oral duels with such expert controversialists as Lloyd George and Churchill; his mind worked rather slowly and he was reluctant to state all the facts in the presence of a score of Cabinet officials for he soon learned from bitter experience that highly confidential military secrets leaked out through these distinguished sources. At times, however, Kitchener scored heavily for he had a clear idea of the war panorama, and of some of these discussions even Lloyd George was forced to say that Kitchener's explanations occasionally "lit up the whole field of war, like a revolving beam of a gigantic lighthouse." Lord Birkenhead also appreciated Kitchener and undertook to interpret his ideas to the Cabinet when Kitchener failed.

Supported by Asquith and Birkenhead, Kitchener survived the Cabinet ordeals although he had made himself vulnerable to attack by permitting various side-shows such as Saloniki, Dardanelles, Mesopotamia, and Palestine to absorb men and munitions that could have been more effectively employed on the Western Front. Nor did he, at first, appreciate the importance of an abundant supply of ammunition. The fact that Kitchener was only partly responsible for the side-shows and entirely blameless for the original shortage of machine guns, heavy artillery, and high explosive shells could not be explained without compromising the entire Cabinet. The fact that civilian contractors in Great Britain and the United States were completely unable to make the promised deliveries on schedule could not be published without informing Germany. So Kitchener and Asquith became the targets for the inside critics and intriguers, of whom there was an abundance in London and with the Army in France.

Asquith in October, 1914, appointed a Committee on Munitions under Kitchener's chairmanship. In April, 1915, he made Lloyd George Chairman of the Committee in place of Kitchener, and in a few weeks the Committee was turned into the Ministry of Munitions with Lloyd George at the head of it. During this evolution, Lloyd George and Kitchener frequently disagreed sharply, but Asquith was usually able to soften their disagreements, and when the final arrangement was made Kitchener loyally accepted the new situation. In speaking of Lloyd George after one of their frequent differences, Kitchener said: "The little Welshman is peppery, but he means to win —which is what matters." Kitchener took the same high ground with Churchill, assuming that his criticism was of a constructive nature and answering it accordingly.

AS the war dragged through the fall of 1915, the Cabinet, the Army, and the Navy split over the evacuation of the Dardanelles. Finally, Asquith sent Kitchener to inspect the situation on Gallipoli, and when he reported that evacuation was inevitable, Asquith acquiesced. He telephoned his approval to Kitchener and suggested he remain in Egypt until the full shock of the evacuation should be felt in the Near East. It is openly said that Asquith was paving the way for Kitchener's removal from the Cabinet by making him Commander-in-Chief in the Eastern Mediterranean; if so, and there is some sustaining evidence, this is the only occasion on record where Asquith did not act in a straightforward manner with Kitchener.

General Birdwood, who had served with Kitchener in India, was in command of the evacuation. After its successful accomplishment, he wrote a personal letter to Kitchener describing the event, beginning "My dear old Chief." Throughout this whole letter there is evident an affectionate devotion that only the worthy great ever inspire. Birdwood writes "Though I was . . . determined to do my best to see this thing through successfully for its own sake . . . yet I have felt very much indeed about you all the time, my dear old Chief. I quite realized that had we made a failure of it, . . . there would have been an outcry at home . . . people would have begun to abuse even you for the Dardanelles policy . . . and I was determined that this should not be the case. . . ." To the stranger, Kitchener may have appeared forbidding but among his military family he inspired an almost religious devotion. This devotion Kitchener took for granted and rarely returned the affection he inspired; one striking exception indicating that he could feel deeply, was his bursting into tears when he first learned of the death of General Hubert Hamilton.

In December, 1915, Kitchener was relieved of many of his duties by the appoint-

ment of General Sir William Robertson as Chief of the Imperial General Staff. Robertson was a favorite of Kitchener and his experience as Quartermaster General and Chief of Staff of the Expeditionary Force was excellent preparation for his new position. He was alarmed at the prospect of serving as Kitchener's aide for he was familiar with the service-gossip that Kitchener extended little authority to his subordinates. Accordingly, he attached certain conditions to his acceptance of the position, which Kitchener, with some slight amendment, accepted and these two thereafter worked in harmony.

There is an abundance of evidence that Kitchener did tend towards over-centralization, but Robertson bears witness that he did not invade the domain of the Chief of Staff. Sir John Cowans, an exceptionally capable officer, who was Quartermaster General of the British Army throughout the war, was another subordinate on whose department Kitchener never encroached. Friends of Kitchener assert that once he found a subordinate dependable, he would allow him ample initiative, that he only intervened when a subordinate was incapable.

Kitchener's critics took the appointment of Robertson as their justification, continued their attacks, and finally assailed him in the House of Commons. Kitchener made an exceedingly effective reply in a confidential meeting of members of the Commons, in which he answered his critics in detail. This was Kitchener's personal triumph for he bared himself before his accusers, gave reasons for his actions except where the operations of England's Allies were involved, and convinced the majority of his hearers.

This was his last public appearance before he undertook the journey to Russia which ended in his dramatic death when the cruiser *Hampshire* was mined. His last effort for Britain emphasizes the influence he exercised abroad; no person in England enjoyed as much prestige in Europe as did Kitchener and he always placed it at the command of his country. He could urge King Constantine to join the Allies, chide the Russians for their inefficiency, encourage the Italians, or rebuke the French with equal assurance. Asquith held him in reserve for their difficult negotiations; and, describing a conference with Joffre and Gallieni about Saloniki, Asquith says Kitchener "played his part of the sullen, morose, rather suspicious but wholly determined man with good effect."

SO firm was Kitchener's grip upon the imagination of his countrymen that among those matter-of-fact people arose a belief that Kitchener was not dead but was held as a prisoner in Germany. This legend persisted despite official denials, until the armistice revealed the truth, so that in his death Kitchener continued the legendary figure he had been throughout his life. This legend suggests Kitchener's answer made in the early days of the war to the Prince of Wales, who, very anxious to get to the front, asked, "What difference does *it* make if I am killed? I have three brothers." Kitchener slowly replied, "If it were only a question of your death, I would not be justified in refusing your request, but if you should be captured it would be a great triumph for Germany." Had Kitchener been captured it would have been a considerable triumph for Germany, whereas his death placed a seal upon his services and he continued, as in his life, to be the symbol of his country's determination to win the war.

In September, 1916, Asquith's eldest son, Raymond, was killed in battle in France. This was a grievous blow, for Raymond had had an even more brilliant career at Oxford than his father, and much was expected of him. Asquith had jealously guarded his inner family life, but he could not conceal his enormous pride and affection for his brilliant first-born, nor could he hide the crushing effect of his death. He found solace in his labors.

HE was reserved for still another trial: there had been increasing dissatisfaction in the conduct of the war; there were critics in and out of the Cabinet, and by November, 1916, various members of the Cabinet were submitting memoranda on the conduct of the war. This is a danger-signal in Cabinet circles, for it is evidence that members are anxious to get their views on record, so that if future events are unfortunate, the precious memorandum can be produced to absolve the individual from any of the collective blame, but if the future turn out happily, the memorandum can be conveniently forgotten.

There was agitation about compulsory service, for speeding up the munitions program, for a more active prosecution of the war. Lloyd George gradually came to personify the discontented element, with Bonar Law as his first assistant. In truth, there was much to criticize. Asquith, alone, seemed unaware of the plan to displace him but when he was confronted with two alternatives by Lloyd George, both of which actually deprived Asquith of all authority in the conduct of the war, he sent his resignation to the King and advised that Bonar Law be sent for. After several days of conference, Bonar Law was unable to form a government and Lloyd George accepted the premiership and, with Bonar Law's assistance, formed the Second Coalition Cabinet. Asquith bore himself well during the crisis, made no reference to the ingratitude of his former colleagues and eventually took upon himself the duty of leading the opposition. Invited to take a minor position in the Cabinet, he hesitated for a while and before coming to a decision, consulted his friends. Thus in the end as the beginning, Asquith stopped for a conference with his friends before making a decision. This ruling trait enabled him in the quiet days of peace to find a meeting place for minds, to pool the mental resources of his colleagues, to compose the incessant difficulties that continually arise in a cabinet and to round the sharp corners without upsetting his political cart. But this method worked badly in war, and his patience with his colleagues finally became a positive menace to his country.

It is easy to point to various mistakes made by Asquith and Kitchener; but it would be difficult to suggest two substitutes who would have stood the test of war as did this pair of eminent Englishmen: the Statesman, the product of England itself and the parliamentary system, the Field Marshal developed on the outskirts of the empire into a soldier, administrator, and proconsul.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

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Single Court of Patent Appeals

A PROPOSAL for a single court of patent appeals has been put forward in very lucid form by Edwin J. Pringle, Esq. Although similar suggestions have been offered in the past, we feel that Mr. Pringle is to be congratulated in formulating the present outline so that its many advantages can be easily understood by both the layman and the lawyer. We present below the essentials of *his plan.*

**MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—*The Editor.***

BECAUSE of the peculiar nature of the patent monopoly, the present system of appeals in patent infringement suits in the United States is the most inefficient, expensive, and wasteful to be found anywhere. It is a deterrent to the production of inventions, and to the investment of capital in patents. Correction of this condition is by far the greatest need of our patent system.

For the first century of our patent system, there was a single court of patent appeals, —and that was the Supreme Court of the United States. But this court became so overburdened with work that, in 1891, the appeal to the Supreme Court was taken away; and the country was divided into nine circuits (now ten), each of which was provided with a Circuit Court of Appeals, which has final jurisdiction of all patent appeals in its circuit.

These courts are independent of each other. While, under the doctrine of comity, unless they see substantial reasons for not doing so, they follow a previous decision by the court of appeals of another circuit on the same patent, still they are at liberty to decide oppositely, and frequently do so. Each court of appeals is supreme in its own circuit, so that there are, in effect, ten independent supreme courts for patents.

As stated, there is no appeal to the Supreme Court. The only right is that of petitioning the Supreme Court to grant a writ of certiorari ordering the case to be sent up to it. The Supreme Court has such an enormous volume of work that it does not take up a patent case unless there is some question of public importance or of interpretation of law, or unless the Circuit Courts of Appeals of two Circuits have decided the same question concerning the same patent in opposite ways.

The decision of a single circuit court of appeals is final in most branches of the law (practically the only other exceptions being copyright and trademark matters); but it is not so as to patents.

The monopoly which a patent grants is a negative one. The patentee is not granted the right, himself, to make, use, or sell the patented invention—a *positive* monopoly. He already has that right because of his inventorship, unless in doing so he would have to use that which has already been patented to another. The patent merely grants him the *negative* right to exclude all others throughout the United States, from making, using, and selling the patented invention. To be of any value to him, his monopoly must be maintained inviolate. If there is one infringer anywhere in the United States who has been rendered immune from the patent by a final decision, it will greatly impair and may largely destroy the value of the patent. One hole that cannot be stopped may sink a ship.

Under these circumstances, to make it necessary that the patent shall have been adjudicated oppositely in two separate circuit courts of appeal, before the mere right shall exist to petition the one court which can render a final decision, the Supreme Court, to take it up, is a shocking economic waste.

A patent may be valid in one circuit and invalid in another. It may have been given a broad, inclusive interpretation in one circuit, and a narrow one in another. It may be infringed by a given construction in one circuit, and not infringed by the same construction in another. A defendant in whose favor a patent has been held invalid, or not infringed, in one circuit, is free to make, use, and sell in every other circuit; and the patentee cannot even enjoin his agents or customers. Thus, in a single circuit, a patent may be invalid as to one person or corporation and valid as to everyone else, or *vice versa.* Even if a patent has been sustained in two circuits, there are still eight circuits, any one of which could decide to the contrary; so that the standing of the patent still is in doubt and infringers still may be tempted to take the risk.

If the first of two decisions by a different circuit court of appeals is against a patent, and the Supreme Court decides in favor of the patent, it almost invariably is too late for the decision of the Supreme Court to affect the first case; and the defendant in that case is free to infringe the patent throughout the remainder of its life, and throughout the whole country.

Furthermore, the statute provides that where the patent covers more than the patentee invented, he must, with reasonable promptness, file a disclaimer in the Patent Office, disclaiming that which is not his invention. Where in the first suit under the patent a Court of Appeals holds a claim to be invalid, it must be promptly disclaimed, under penalty of the patentee losing the right to bring other suits under the patent. The law provides that the disclaimer becomes a part of the patent. It is effective throughout the United States in all circuits. Therefore, if another Circuit Court of Appeals in a second suit on the same patent holds the claims to be valid, which were disclaimed in the first suit, and the Supreme Court then, on Writ of Certiorari held the said claims to be valid, it almost invariably would be too late, under the statute, for the Supreme Court to afford relief. Thus the patent irretrievably would have been emasculated, because of the plurality of Courts of Appeals; while, with a single Court of Patent Appeals, the validity of the claims could be finally determined before any disclaimer was filed.

Moreover, by the time the patentee has obtained a favorable decision in a second circuit in any of these cases, a large proportion of the short life of the patent (seventeen years) usually has expired, with no substantial reward to the inventor.

The expenses of these repeated litigations make them impossible to the individual, and constitute a burden from incurring which even the large corporations shrink.

With ten courts of appeals, there are unavoidable differences of opinion on various points of law and differences of tradition as to the liberality or strictness of construction to be applied to a patent under the same circumstances. But, under a single court of patent appeals, the administration of the patent law would attain completeness and certainty and uniformity of application in these and other respects, which it now lacks.

Patents also involve many difficult questions of science and engineering, upon which judges may and often differ; thus it is impossible that the decisions of the various circuit courts of appeals on the same patent shall always be uniform.

Quite as many of the patents that are adjudicated are held to be invalid as are sustained. Both the public and the patentee, therefore, need to know, early in the life of the patent, whether or not the patent is valid, and what is its scope. If the patent is invalid, the public should know it, and not be kept in uncertainty for years, during which it would have been free to use the alleged invention described in the patent, if a single final decision could have been obtained. On the other hand, if the patent is valid, the patentee, early in the life of his patent, should have a single decision which applies throughout the United States and which would hold against all subsequent defendants, unless they set up defenses which are substantially different from those considered in the first suit, or unless they use a structure which does not come within the monopoly of the patent as determined in the first suit.

The patent should be adjudged as to validity, scope, and infringement, on the same principles and policy throughout the United States, both for the sake of the public and the patentee.

The head of the patent department of one of the largest corporations in this country said to the writer recently, "Whether a patent is valid or invalid, we want, early in its life, to know definitely, so that we may shape our course accordingly, and

with confidence that the situation will not be changed during the life of the patent, except for substantial reasons."

Therefore, the only solution of the difficulty is a Single Court of Patent Appeals.

Inventor Convicted of Fraud

CLARK W. PARKER, 69-year-old inventor, and his son, Wyman C. Parker, were found guilty recently of using the mails to defraud by a jury in Federal Judge John M. Woolsey's court, in connection with the promotion of the Automotive Royalties Company, Inc.

Two employees, H. E. Seymour and H. S. Vail, who for three weeks stood joint trial with the Parkers, were found not guilty.

The Parkers, it was charged, defrauded 700 prospective investors in the automotive stock of 1,100,000 dollars in the last four years. Clark Parker is the inventor of a rotary engine, which, according to pamphlets sent through the mails to further stock sales, was to "revolutionize the automobile and airplane industry."

Fruit Mark Registered

IN a recent decision, First Assistant Commissioner Kinnan held that the Sun-Maid Raisin Growers of California, of Fresno, California, is entitled to register, as a trademark for canned fruits and other food products, a mark consisting of a representation of the sun having within its circumference a picture of a young girl and the words "Sun-Maid" appearing therebelow, notwithstanding the prior adoption and use on similar goods by the California Packing Corporation, of San Francisco, California, of the term "Sun-Kist."

The ground of the decision is that the marks are not confusingly similar.

In his decision, after stating that there was in the record a contract between the parties involved, made as a basis for the dismissal of an infringement suit, and that each party had sought to construe that contract in its favor, the First Assistant Commissioner said:

"It will be sufficient to here note that this contract, the construction of its terms, its effect as an estoppel and, in fact, any effect which it may have upon the instant proceedings, is not before this tribunal to determine. The sole question here is whether the registration of the applicant's mark would damage the opposer by reason of probable confusion in trade."

With reference to the marks he said:

"The marks alleged to be in conflict have nothing in common but the word 'Sun,' and in each instance, it is connected by a hyphen with a second and wholly dissimilar word. The applicant's mark includes many other more distinctive and fanciful features totally absent from the opposer's mark."

Naval Officer Loses Suit

REAR ADMIRAL BRADLEY A. FISKE (retired) recently lost a suit for 198,000 dollars against Rear Admiral William A. Moffett, Chief of the Navy Bureau of Aeronautics, for alleged infringement of [illegible] torpedo dropping device.

The District of Columbia Court of Appeals reversed the judgment of the District of Columbia Supreme Court a year ago awarding to Admiral Fiske that amount. The retired officer contended that the Navy used the device on 397 planes without his authority. The Appeals Court held that Admiral Fiske's patent was inoperative and that the government was entitled to an irrevocable license to use the inventions made while Fiske was a naval officer.

Colored Film Mark Upheld

RECENTLY, Assistant Commissioner Moore held that Consolidated Film Industries, Inc., of New York, is entitled to register, under the Act of 1905, as a trademark for motion picture films, the term "Magnacolor," notwithstanding prior registration by another (registration No. 264,952) of the term "Magnafilm" as a trademark for motion picture photoplays, the ground of the decision being that these marks are not confusingly similar.

In his decision the Assistant Commissioner stated that the marks do not look alike, sound alike, nor have the same signification and that the registered mark conveys the idea of a great film while the applicant's mark conveys the idea of a great color. He then, after noting that applicant had called attention to a number of registrations consisting either of the word "magna" alone or "magna" used as a prefix in a compound word, said:

"The word 'Magna,' when used as a part of a trademark, being generally regarded as an adjunct to the noun which it qualifies, it may not properly be held to be the dominant part of the mark.

"In view of the above, I am of the opinion that the reason advanced by the examiner is not sufficient to justify the refusal to register the applicant's mark."

"Dog Remedies" Not Remedies

THE government scored a victory in a contested court case involving four veterinary drug preparations when the United States District Court at New Orleans, Louisiana, upheld seizure of misbranded "dog remedies," sold by the S. A. Crisp Canine Company, Blacksburg, South Carolina, to a New Orleans firm, said W. G. Campbell, Director of Regulatory Work, U. S. Department of Agriculture, in a comment on reports of the case which have reached the department. This company contested Federal seizure of shipments of Crisp's Tung-Tone, Crisp's Distemperte, Crisp's Black Tongue Remedy, and Crisp's Hot Shot, held by the government to be misbranded under the Federal Food and Drugs Act.

Analysis of Crisp's Tung-Tone Black Tongue Preventive, made by government chemists, showed the product to consist largely of calomel, baking soda, and a small amount of charcoal. Crisp's Black Tongue Remedy, in capsule form, was found to consist principally of calomel, soda, and charcoal, while the liquid was made up principally of milk of magnesia, precipitated chalk, charcoal, and water. Analysis of Crisp's Distemperte proved the preparation to be made up largely of kerosene oil, spirit of turpentine, and pine tar. Government chemists found Crisp's Hot Shot Running Fit Remedy to contain considerable amounts of spirit of turpentine, petroleum oil, tarry material, water, and milk of magnesia.

"Some of the leading veterinarians of the United States testified at this trial," said Mr. Campbell, "and it was their opinion that there is no drug nor combination of drugs known to veterinary science which can truthfully be offered as a treatment for distemper. The same holds true for black-tongue, save that feeding substances which supply a satisfactory dosage of vitamin G may prevent the disease or cure it in the early stages. When shipped interstate, dog medicines, accompanied by labels or circulars in which the products are described as effective treatments for ailments now considered incurable by the use of drugs, or in which appear statements going beyond what may be properly promised for the products, violate the Federal Food and Drugs Act. Such products are subject to seizure and such misbranding renders shippers liable to prosecution under the law."

Courts Disagree on Film Copyrights

THE Federal Courts for the Districts of Massachusetts and Maryland have recently handed down contrary decisions on the question of whether an unauthorized exhibition of a copyrighted motion picture film constitutes an infringement of the copyright, reports *The United States Daily*.

Judge Morton, of Massachusetts, concluded that provisions of the copyright statutes, either expressly or by implication, do not give to the owner of a copyrighted film a right of action for infringement based on the unauthorized showing of the film.

Judge Coleman, of Maryland, decided that the general provisions of Section 1 of the Copyright Act were applicable to a situation where a film is exhibited without authority, on the ground that a motion picture photoplay is a "dramatic work" within the meaning of that term as used in the statute.

"Cine-Tone" Refused Registration

IN the case of Powers Cinephone Equipment Corporation *versus* The De Vry Corporation, First Assistant Commissioner Kinnan held that The De Vry Corporation, of Chicago, Illinois, is not entitled to register, as a trademark for "unitary apparatus for synchronous reproduction of light and sound effects," the notation "Cine-Tone," in view of the prior adoption and use by the Powers Cinephone Equipment Corporation, of New York, New York, of the term "Cinephone" as a trademark for talking motion picture films.

The First Assistant Commissioner said:

"It is clear enough that the films employed by the opposer and upon which it uses its mark are to be used in connection with the general class of apparatus upon which the applicant applies its mark. It is considered, especially in view of the recent holdings of the Court of Customs and Patent Appeals relied upon by the opposer, that the goods belong to the same class within the meaning of the trademark statutes.

"The marks are deemed confusingly similar. They are spelled somewhat alike, sound somewhat alike, and have the same general significance. The applicant, it would clearly appear, should have selected a mark, since it had an unlimited field from which to make its choice, which is not so nearly like that of the opposer."

Books SELECTED BY THE EDITORS

THE NAVIGATION OF THE AIR, AND METEOROLOGY
By Capt. Leslie S. Potter

THE most complete text on the subject now available. From elementary principles—use of instruments, reading maps, and so on—to detailed exposition of how to plot courses, allow for variation and deviation due to weather or instruments, all the practical considerations are given for cross-country or night flying. There is also an entire section on navigation by radio and another on meteorology and weather forecasting. Because of its completeness and up-to-dateness it is an ideal reference also for older pilots.—$4.20 postpaid.

AERIAL AND MARINE NAVIGATION TABLES
By John E. Gingrich, Lieut. U. S. Navy

TABLES for the use of the aviator, practical navigator, and yachtsman in solving the line of position problem with the use of only simple computation. When used with the Nautical Almanac no other books are necessary for navigation purposes. The tables can be used with either sea horizon or bubble sextant, and are carefully designed for simplicity and accuracy, and ease and rapidity of use.—$2.65 postpaid.

AIR TRANSPORT OPERATION
By Wesley L. Smith, Ch. Eng. "N.A.T."

A THOROUGH analytic study and a practical handbook of commercial aviation. Every aspect of the work—the whole physical system, from airways to instruments, and the procedure of operation—is covered in detail from two angles; (1) What has already been accomplished, what must yet be done and probable avenues of future development in lowering costs and establishing safety and efficiency; and (2) The relative advantages of various types of the several parts of the system and their operation and maintenance in practical use. —$4.20 postpaid.

WINGS OF TOMORROW
By Juan de la Cierva and Don Rose

THIS story of the Autogiro related in an easy conversational style by its inventor, carries the reader through the various stages of the development of this fundamentally safe aircraft from the days of the first "ugly ducklings" to the present when it is proclaimed by many as "the aircraft of the future." "Wings of Tomorrow" tells in simple terms of the development of the flight theory of the "flying windmill," of the early experiments with it, and of how the modern, efficient offspring works. It contains a wealth of human interest anecdotes relating to the inventor's persistence in the face of difficulties and will therefore interest the merest dabbler in aviation as well as serve as a reference for the more advanced student.—$2.65 postpaid.—*F. D. McH.*

A TEXT-BOOK OF PHYSICS
By L. B. Spinney, Prof. Phys. Iowa State College

THIS is an introductory physics and is in wide use in colleges. It is not so well adapted to the average outside student or reader as certain others, being less explanatory and somewhat more mathematical. For those who like the latter kind of work, this is the book. —$3.90 postpaid.—*A. G. I.*

MECHANISM
By R. McA. Keown. Revised by V. M. Faires, Prof. Mech. Eng., Texas Agric. and Mech. College

THIS work fits right in with Jones' "Ingenious Mechanisms" for it gives the sound and simpler elements upon which the latter is built. Cams, centros, linear and angular velocity, gearing of all kinds including trains, intermittent motions, and an appendix giving gear-tooth construction, adequately cover the fundamentals. An up-to-date revision of a standard text in the field for a long period of years and a reference essential for designers or inventors.—$2.65 postpaid.

BRIDGE ENGINEERING
By F. O. Dufour and C. P. Schautz

ESPECIALLY adapted for home study, utmost care has been used to keep the treatment within the range of common understanding for the beginner and self taught practical man. For this reason it also makes a quick, ready reference for the technically trained man who is brushing up generally or who desires to clear up some rusty point in his memory—as we all have occasion to do from time to time. The first author is well known for his technical knowledge as evinced in previous works, and the second is Asst. Engr. of Bridges, Penna. R. R.—$3.20 postpaid.

RADIO ENCYCLOPEDIA
Edited by S. Gernsback

FROM "'A' Battery" through to "Zones, Radio Licensing," this large volume, (9 by 12 inches), bound in loose leaf form with flexible covers, provides the traditional mine of information on all things radio. Replete circuits, explanatory diagrams of all kinds, and half tones, it deals with the various phases of radio in a manner that has been kept as non-technical as is consistent with clarity and accuracy. Appendices give call letters, vacuum tube socket charts for standard sets, and a radio set table listing data on all receivers. This second edition has been revised and brought up-to-date in every respect, and is a book that should find a ready welcome in the hands of everyone who is at all interested in radio.—$4.20 postpaid.—*A. P. P.*

RADIO RECEIVING TUBES
By James A. Moyer, Director, and John F. Wostrel, Instr. Radio Engr., Univ. Extension, Mass. Dept. Education

ESSENTIAL principles underlying the operation of vacuum tubes are explained in as nontechnical a manner as is consistent with accuracy. The construction, action, reactivation, testing, and use of vacuum tubes is covered as well as specifications for vacuum tubes and applications for distant control of industrial processes and precision measurements. This revision covers latest improvements in types of tubes and new devices for utilizing radio receiving tubes.—$2.65 postpaid.

CINEMATIC DESIGN
By Leonard Hacker

ADDRESSED to the serious minded amateur motion-picture photographer, this volume deals with the modernistic and artistic side of cinematography, stressing the esthetic and deprecating the realistic. Essentially it is a handbook which strives to lead the amateur

through form, rhythm, and color, to a series of typical scenarios designed to stimulate the imagination to a point where originality will take charge. "Cinematic Design" may prove a boon to those artistic souls who feel that they have exhausted the possibilities of their movies cameras on children, friends, and relatives, and who will welcome a new source of expression via the screen. —$2.65 postpaid.—*A. P. P.*

MAKERS OF CHEMISTRY
By Eric John Holmyard

THIS is an out-and-out history of the science of chemistry, from the earliest times to our own age, intended for the average intelligent non-specializing reader. It is not technical on the one hand, nor a light-weight, sugar-coated story book on the other, but a good straightforward survey written without frills, but equally without the deadly droning style of some books we have seen. It is neatly produced, is especially well illustrated from the point of view of interest, and contains 302 text pages. —$2.65 postpaid.—*A. G. I.*

NEW DISCOVERIES RELATING TO THE ANTIQUITY OF MAN
By Sir Arthur Keith, Prof. Royal College of Surgeons

SINCE the author's famous work "The Antiquity of Man" was last revised in 1925 a remarkably large number of important finds of ancient man have been made. The present volume brings the subject down to date, including detailed discussions of the Taungs skull (*Australopithecus*), the Springbok skull, the Galilee (Neandertal type) skull, Peking man, the Ehringsdorf find, the new Neandertal finds in Spain, Italy, and Russia, the great Moravian discoveries, the London skull of high antiquity, the puzzling Neandertaloid skull from Greenland, and others. Sir Arthur Keith is known not only as a brilliant scientist but as an equally brilliant writer. His books drive the sandman away. All who are interested in our rapidly expanding view of ancient man should possess a copy of this outstanding work.—$5.20 postpaid.—*A. G. I.*

THE STORY OF SCIENCE
By David Dietz

WITHIN its two covers this book contains in readable yet thoroughly reliable form about all the science the average adult individual is likely to want to absorb. In plan this work covers systematically almost as much ground as a textbook—or rather four textbooks, since it deals, seriatim, with astronomy, geology, physics, and biology—but it has none of the stereotyped earmarks of the textbook, being written in simple language. Its author has had plenty of experience in writing entertainingly about science and knows the mind of the average reader. As the four sciences treated represent the bulk of modern science the reader who carries away the contents of this book may consider that he has a pretty good amateur background in general science.—$3.65 postpaid.—*A. G. I.*

SCIENCE AND RELIGION, A SYMPOSIUM
By Pupin, Huxley, Thomson, Haldane, Eddington; also Dean Inge and several other divines

WHETHER the reader favors the rather recent trend in which science and religion appear to have made peace, or whether on the other hand he is in agreement with Professor Pearl who regards much of this trend in the light of a "sickly mysticism now emitted in such great volume by eminent physicists," this small book (172 pages) will set him thinking and possibly stir him up. It is not, however, disputatious in tone but quite the reverse, the warfare of science being mainly with theology, not religion as such. Thinkers who like to keep up with philosophic matters should read these collected essays by eminent men. -$1.90 postpaid. —*A. G. I.*

ASTRONOMY
By F. R. Moulton

TEXTBOOKS on astronomy keep on appearing and now there are at least half a dozen. What excuse is there for another? Moulton's new book (and this really is a new book, not the old Moulton textbook merely warmed over) contains its own "excuse"; it strikes us as probably the most readable textbook thus far made available, and the best adapted to general readers outside of the college class room. Moulton never is dry; his writing is a living thing, just as is his lecturing. In this book he has devoted more than 75 percent of the 533 pages to things within the solar system. Thus the average reader will find the book more comfortable going than astrophysics; the remaining quarter portion covers that aspect of astronomy as fully as the average reader, unless studying to be a professional astronomer, will care to go. The book is an attractive handful—nice paper, good print, trim, tough binding.—$3.90 postpaid.—*A. G. I.*

PLANT LIFE THROUGH THE AGES
By A. C. Seward, F. R. S., Prof. Botany, Cambridge Univ.

ALTHOUGH there are plenty of books on the evolutionary history of the animal kingdom there are relatively few—in fact, only a handful—on that of the great vegetable kingdom. This large work written by a noted authority on paleobotany traces the evolution of plants, including trees of course, from their first emergence all the way down to the present day. Although the book contains an introductory summary of historical geology and a classification of plants, the reader who has not previously studied a little elementary geology and botany is likely to obtain a sketchy idea of the background against which the work was written—something like building a stone house on two slender props of wood. Intrinsically, outside of this consideration, the book is a praiseworthy account of a fascinating science. —$10.20 postpaid.—*A. G. I.*

FACTS AND FETISHES IN ADVERTISING
By E. T. Gundlach

MANY a good hearty dig and much common sense and straight reasoning is to be found in this extended comment on the idiosyncrasies of advertising. One wonders often while reading this most entertaining analysis how an advertising man can himself so readily dissect the ridiculous yet age-old adages by which the whole profession is obsessed. Stripped of its mechanical dressing much of the special jargon is seen to be of little sense and less logic—current today only by uncomprehending repetition. This is a book that will surely be read by all having anything to do with advertising, if for no other reason than curiosity as to what is blasted therein.—$5.25 postpaid.

MRS. WILLIAM VAUGHN MOODY'S COOK BOOK

IF you are tired of the usual recipes, or if for special occasions you desire epicurean fare of superlative excellence, this is just the book. It is cookery on its highest plane yet nonetheless serviceable, practical, and comprehensive, the range running from hors d'œuvres (a particularly notable section) up through salads, sweets, beverages, canapes, bread rolls, and muffins. The author is well known as perhaps the outstanding authority and the recipes are thoroughly tested.—$3.65 postpaid.

SCIENTIFIC AMERICAN ADVERTISERS

SEPTEMBER · 1931

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6 North Michigan Ave., Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Western Advertising Representative: Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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Vol. 145, No. 3. Price 35 cents a copy. $4.00 a year. Foreign $5.00. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year, postage prepaid.

THEN AS NOW

1845 - 1931

With a magnifying glass read the above text and you will know from C. L. Sholes, the inventor of the first commercial typewriter, what importance he placed on the information obtained from Scientific American.

A few months ago we described the latest electrically operated typewriter, again a new typewriter for the blind, and in this issue you will find the latest pneumatic duplicator development.

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Consider your Adam's Apple!!★

Don't Rasp Your Throat With Harsh Irritants

"Reach for a LUCKY instead"

Now! Please!—Actually put your finger on your Adam's Apple. Touch it—your Adam's Apple—Do you know you are actually touching your larynx?—This is your voice box—it contains your vocal chords. When you consider your Adam's Apple you are considering your throat—your vocal chords. Don't rasp your throat with harsh irritants—Reach for a LUCKY instead—Remember, LUCKY STRIKE is the only cigarette in America that through its exclusive "TOASTING" process expels certain harsh irritants present in all raw tobaccos. These expelled irritants are sold to manufacturers of chemical compounds. They are not present in your LUCKY STRIKE. And so we say "Consider your Adam's Apple."

TUNE IN—The Lucky Strike Dance Orchestra, every Tuesday, Thursday and Saturday evening over N. B. C. networks.

S.S. East Indian and Lake Ormoc, of the Ford Fleet

DESTINED FOR DETROIT

IN THE DAYS when the life and energy of New England were expressed in terms of sailing-ships and adventurous voyaging, the little port of Salem meant more to the people of Malaysia than all the American Colonies together!

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As far places contribute to the production of the Ford automobile, civilization gains by its use.

FORD MOTOR COMPANY

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Owned and published by Scientific American Publishing Company Orson D Munn, President Louis S Treadwell Vice President John P Davis Treasurer I Sheldon Tilney Secretary all at 24 West 40th Street New York N Y

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · OCTOBER · 1931

SCIENTIFIC AMERICAN, October 1931, Vol. 145. No. 4 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Subscription price $4.00 per year. Foreign $5.00.

ACROSS THE EDITOR'S DESK

WHEN an organization devoted, not to profit but to service to humanity, has been in active operation for 50 years, with constantly increasing efficiency and scope, it is obvious that its very foundations must have been laid with rare foresight Such is the case with the Red Cross, this year celebrating its 50th anniversary In times of peace and in times of war this world wide group of earnest workers has carried on with a vigor that has made its insignia symbolical of aid to the suffering There is not to be found a parallel case in the annals of history, and we take this occasion with the publication of a short resume of the work of the Red Cross, to extend to them a hearty vote of thanks for their past work, and a hope for a future even more brilliant

•

In our issue for August 1931 we presented an article on Carl Akeley's Africa," telling something of the work of this eminent naturalist in the wilds of what was formerly known as 'darkest Africa Thanks to his enterprise, the appellation has been changed to lightest" and much knowledge of that vast continent has been made available One of Akeley's fondest dreams has, since his death been ably carried on by his wife, and from her pen we have obtained an article telling in detail of Africa's first national park If the publication of such material does nothing more than dispel many erroneous impressions regarding Africa it will have served its intended purpose

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Probably the majority, if not all, of us have at some time read wildly imaginative stories of life on Mars or some one of the other planets Such stories make interesting light reading if one does not try to see too far beyond the actual written words, but when subjected to the scrutiny of science they are found to be nothing but froth, with little or no background of fact When the man of science approaches such a subject, he takes into consideration many phases that are ignored by the fiction writer and bases his analysis on known laws of science An article backed by just such reasoning has been prepared for us by a Fellow of the American Association for the Advancement of Science, Prof Edwin Lincoln Murray, and is scheduled for November The subject of his discourse is Are there men in other worlds? and his treatment of it will furnish much food for thought

•

Extravagant claims in millions of words are so often made for half baked schemes—which are then wholly forgotten—that the public generally has become somewhat chary of unique developments Thus because little has been heard in recent years of the Emmett mercury vapor and water vapor power generation scheme, some people believe that the idea has been abandoned One man recently asked us if it had not proved unsuitable" "No," we told him It has proved eminently practicable ' The efficiency of one plant that has been operating for some time shows this the plans for construction of two new, but larger, plants indicate it and an article covering this unique process to be published in a coming issue will point out the reasons

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There is an old saying among prospectors for gold that gold is where you find it and in spite of the huge quantities of oil and gas that are being produced today the same saying may be applied to them But—and this is a big BUT—geologists have learned that they are found in certain places Just where these places are is the problem that must be solved and the path toward this solution is one which science is treading with a stride that becomes more assured as knowledge of the subject increases An article soon to be published tells of the progress that has been made

•

You buy a railroad ticket, board the train the ticket is punched, possibly several times and finally collected As far as you are concerned, that is the end of that ticket But behind the little rectangle of cardboard or the strip of folded paper is a history and a future that is complicated and interesting From the printer's press to the macerating machine, the beginning and end of the ticket, its life and route are vital to the railroad industry We have reduced this life history to an illustrated article that will give you a better realization of how the business of railroading is run It is scheduled for next month

Orson D. Munn

ARTHUR I. KENDALL

A NEW discovery which seems destined to open up a vast realm of understanding of disease in a peculiar corner of medical science where almost everything heretofore has remained stubbornly hidden from the view of the vexed bacteriologist, has been made by Professor Arthur I. Kendall of the Northwestern University Medical School. The germs of most diseases are visible under the microscope but those of a few—measles, influenza, the common cold, smallpox, sleeping sickness, and others—apparently were too minute to be seen under the most powerful microscope. In studying germs with a microscope it long has been the standard method to culture them on gelatin, agar-agar, and broths—standard laboratory media. But the germs of the few diseases named always died when an attempt was made to culture them artificially, though they s vived readily enough (quite too readily) within the body. To Dr. Kendall came the inspiration that perhaps the reason lay in the culture medium itself; in the body this would be pure protein, in the laboratory something else. He made a culture medium of pure protein and discovered that these peculiar germs thrived on it. Not only that, but they went through cycles when they became microscopically visible. Other common germs, hitherto thought always visible, underwent an invisible phase. It is not unlikely that this discovery will have a far-reaching effect on practical medicine. At least, more is sure to be heard of it.

THE NEWSROOM RUNS AT HIGH PRESSURE

THE newsroom of The Associated Press is as busy as the Stock Exchange but without its confusion. The men at the left are the editors who prepare the copy for the wires amid the terrific din. The men at the right are turning "copy" in the form of short "takes" into punched ribbon, shown on page 226. This ribbon in turn is fed into sending machines which transmit news at the rate of 60 words a minute to groups of member newspapers, geographically located for economical "hook ups." The same tape can be used for different wires, but news is usually "edited" for various sections, and a new tape made.

Newsroom where news is being edited and tape perforated for transmission by the printer telegraph. Morse operators are still on the job sending corrections and news that would hamper the main circuits

BEHIND THE SCENES OF NEWS GATHERING

By ALBERT A. HOPKINS

WHAT would breakfast be without the morning paper and coffee? We are apt to consider the newspaper as a matter of course; it costs little, it requires little effort to secure and the regularity of issue vies with the punctual rising and setting of the sun. The newspaper limns a picture of the world as it is, and we are apt to forget what work and talent are back of it all. The gathering of news and its dissemination is "big business," if ever there was any, representing an investment of 10,000,000,000 dollars and a yearly turnover of 5,000,000,000 dollars, and giving employment to over a million persons. The daily circulation of newspapers in the United States is 40,000,000, and 27,000,000 on Sundays.

The product is as ephemeral as hot-house fruit or orchids; the news of the morning fades into the afternoon specials with their market quotations, sold on the streets 15 minutes after the market closes. The raw materials consist largely of brains and ground spruce with a little lampblack and varnish thrown in. There is a vast amount of talent employed in getting out issues day after day on time with up-to-the-minute news. While the newspaper is an article of prime necessity, still it is about the only thing that did not go up in price during the World War. We may pay a cent more daily or a few cents more on Sunday, but we are paying the small increase for better news service and quality.

"Meet Mr. Harry French" in charge of the "west wire." He stopped long enough to look up from his task of reading 100,000 words in eight hours. He selects only 30,000 words for transmission to western papers, via high-speed printer-telegraph lines

Never in the history of our time have people been so avid for news and our insatiable eagerness to be informed requires ceaseless activity on the part of reporters and editors who rush feverishly to get the news to the public red-hot, while it is still news. The dean of American journalists, Charles A. Dana, used to say that the newspaper profession is a learned profession in one sense, for the utmost amount of learning can be put to use. Human nature is at the back of all good journalism and the gift for logical presentation of human traits, combined with scholarship, tends to produce a perfect newspaper.

The old-time reporter was just as able and resourceful in his time as the present day alert young man or woman, and there is ample evidence that he could write. He was daring, enterprising, and fully competent to cope with prevailing conditions. The old-timer usually was not harried by the necessity for speed. Even if he were, the reporting of news and the transmission of it to the newspapers was much more leisurely than it is today. Telegraph and telephone and cable systems were not as ex-

Tabulating market reports which come in over the tickers. Twenty men each handle from 40 to 50 stocks and keep them corrected all day

assessment to pay the cost of independently gathering and distributing the news of the world for the common benefit of members of the group and for them alone. There are a number of news gathering associations but the greatest of them all is The Associated Press which operates 225,930 miles of leased wires supplying 897 evening and 389 morning papers, or 1286 in all. Through the courtesy of the officers of this organization we are enabled to describe one of the most romantic and at the same time prosaic businesses in the world.

Each member has one vote and one vote only on all questions save that of the election of directors which, broadly stated, is according to the assessments paid. It is for these reasons that the enterprise is the world's greatest co-operative undertaking. After a member has been in the field for five years, he has a "right of protest" against the election of another member in the same field.

There is a long story back of the formation of this organization but in brief the facts are as follows: The leaders in the newspaper world thought that the prosperity of their properties and indeed the safety of the Republic itself are founded on an undefiled news-service and were unwilling to entrust such a terrifying power to any private group. After a conflict of years the victory of The Associated Press was complete. Now the members have a news-service of their own—their servant and not their master.

A membership in a great city is valuable. When the New York *World* gave up the ghost, the membership was perpetuated by a skeleton newspaper called the New York *Repository*. Should a newspaper want to buy this membership it would probably cost upwards of 500,000 dollars. A membership is often erroneously called a "franchise." New York has eight English language papers having membership—probably enough for the good of the industry.

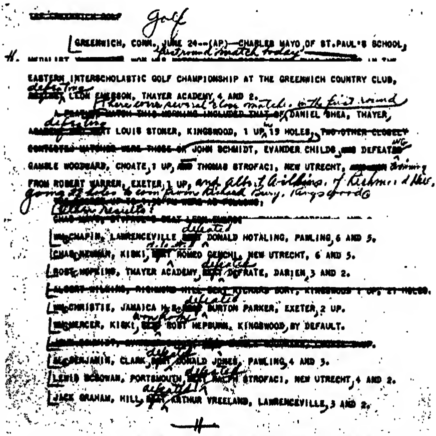
Perforated tape is punched as shown on page 224 and is used for feeding telegraphic transmission machines. About 60 words are on this section of tape

tensive as at present. The radio or wireless telegraph, which is probably the most outstanding development in facilitating the gathering of news from remote spots, was unknown. Today, however, if the editor of a paper in San Francisco cannot obtain a full record of what is going on in India within two hours he feels that The Associated Press has missed the grade.

Capital enables a newspaper to run at a reasonable cost so that it is not swallowed up by expenses that might have been avoided. Out of the struggle to keep on the right side of the ledger has grown co-operative journalism which relieves editors and reporters from much of the drudgery and expense in individual seeking after news. Partial emancipation of the staff from petty and painful detail gives an opportunity for literary form, better English, more checking of facts, and an all around better perspective. The consequence is that perhaps not quite so many men are employed on the newspapers, but the remainder are apt to be better educated and more capable men who have chance to expand.

THE primary and controlling motive and direct purpose of the newspaper is to make money and to do this expenses must be kept down. This is best accomplished by intelligent co-operation in which a group of newspapers combine to exchange news with each other, each member contributing to the common pool the news of his vicinity, and in addition a pro-rata

One thing should be strongly stressed and that is that The Associated Press is a purely mutual organization. There are no stockholders and under their charter it is forbidden to make profits.


Golf

GREENWICH, CONN., JUNE 24--(AP)--CHARLES MAYO OF ST. PAUL'S SCHOOL, first round match today

EASTERN INTERSCHOLASTIC GOLF CHAMPIONSHIP AT THE GREENWICH COUNTRY CLUB, defeating LEON EMERSON, THAYER ACADEMY, 4 AND 2.

There were several close matches in the first round DANIEL SHEA, THAYER, defeating LOUIS STONER, KINGSWOOD, 1 UP in 19 HOLES; JOHN SCHMIDT, EVANDER CHILDS, DEFEATING GAMBLE WOODWARD, CHOATE, 1 UP; THOMAS STROFACI, NEW UTRECHT, winning FROM ROBERT WARREN, EXETER, 1 UP, and

Other results:

CHAPIN, LAWRENCEVILLE, defeated DONALD HOTALING, PAWLING, 6 AND 5.

CHAS. NEWMAN, KISKI, defeated ROMEO GENCHI, NEW UTRECHT, 6 AND 5.

ROBT. HOPKINS, THAYER ACADEMY, defeated DEFRATE, DARIEN, 3 AND 2.

CHRISTIE, JAMAICA H.S., defeated BURTON PARKER, EXETER, 2 UP.

MERCER, KISKI, won from ROBT. HEPBURN, KINGSWOOD, BY DEFAULT.

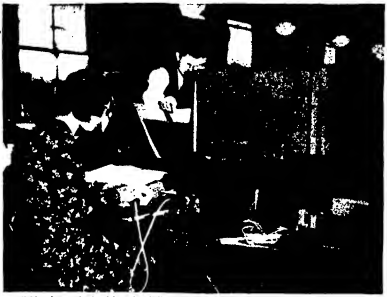
BENJAMIN, CLARK, defeated DONALD JONES, PAWLING, 4 AND 3.

LEWIS McGOWAN, PORTSMOUTH, defeated RALPH STROFACI, NEW UTRECHT, 4 AND 2.

JACK GRAHAM, HILL, defeated ARTHUR VREELAND, LAWRENCEVILLE, 3 AND 2.

A fine example of well-edited copy ready for tape punching. "Blue pencils" exist only in novels and in the movies; the editor's pencil is fat, black, and soft

The Board of Directors of The Associated Press are all active newspaper men selected from all sections of the country and election to the Board is esteemed a high honor. They take their duties very seriously and attendance at the meetings of the Board and the Executive Committee consumes from one to two months of their time each year. President Frank B. Noyes says: "I regard the work of the staff as one of the wonders of the world. News does not collect itself; human endeavor, human sacrifice, human brains are honestly expended in order that you and I may be promptly and accurately informed of the daily happenings of the world."



"Check and double check." Girl pasting up market quotations on sheets for checking. Gummed tape passes from printer over sponge

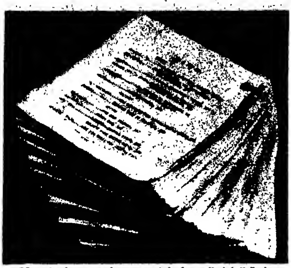
Every event reported by (AP) men t be accurate and unbiased and the news must not be gathered from back stairs gossip. The immediate operation of the service is in the hands of a general manager and since the organiza- n in 1893 there of them—Melville E. Stone, Frederick Roy Martin, and Kent Cooper who now presides over this vast network of detail.

There are regular accredited correspondents in all the principal cities of the world who look after sending portant news in condensed form by or cable. These men are trained ·ican newspaper workers and are ely independent of any one except officials of The Associated Press. Foreign news bureaus are also affiliated with the organization and the names Reuter, Havas, and others are to be found on doors in the New York offices. The cable and wire news is extremely condensed but is "unpacked" and expanded to normal by the cable editors.

The staff proper numbers about 3300 of which 1800 are full time employees and 1500 are what is known as "string" correspondents. To this must, of course, be added the personnel of the individual newspaper members and allied agency staffs. About 80,000 individuals are engaged in securing and transmitting the news. The cost is over 12,000,000 dollars a year which is borne by the individual member newspapers based on the actual s dered, and may vary from 10 dolla week to several hundred dollar day. Natu ly a few hundred words daily should pay as high as those requiring 75,000 words daily.

There are 85 bureaus scattered all over the country, each with its news and photograph file. If a San Francisco newspaper wants a photograph of the Eiffel Tower because a lady just toppled

The heavy lines show 24-hour trunk lines. Papers numbering 1286 are served by 225,930 miles of wire



Here is the copy from an eight-hour "trick." It is roughly fastened together in little books for filing

off, they do not have to send to New York for it. It usually is available locally.

The main office of The Associated Press is located in an office building on Madison Avenue, New York City, and as you leave the elevator you hear a type of noise which is indefinable. This is caused by the typewriters, the Morse instruments, printer telegraphs, tickers, and the hum of conversation incident to this enterprise. This noise and the more dramatic incidents were broadcast one night and it "went over big."

Switchboard through which all telegraph circuits run from N. Y. newsroom of The Associated Press to all parts of the U. S., Canada, and South America

The telegraph and cable are the backbone of communication. There are 225,930 miles of leased wire involved. There are 79,305 miles of twenty-four hour double and triple trunk lines; 15,452 miles of double wires which are used less than twenty-four hours; 92,092 single state and interstate wires; and 39,081 miles of special sporting and financial wires, all leased for the exclusive use of this organization. The news comes in from member newspapers, is edited, and sent out again to the other member newspapers if the editors deem it of sufficient interest.

Nearly all transmission now is done mechanically. A tape is punched by the operator, is examined for errors, and put on transmitting machines which send the electrical impulses over the wires to operate typewriters in the newspaper offices. The great trunk lines—the western circuit, the southern circuit, and so on—carry the news to the great cities. In addition to the main trunk lines there is an elaborate system of state wires over which news of particular states is carried much more fully than is desired in other states. For example: New England is a tight little assemblage of states that is very much interested in New England news. There are 42 of these state or regional circuits. The smaller members without telegraph facilities often receive their news by telephone, a number of papers being on the same telephone circuit.

Mr. Kent Cooper has estimated that the wordage of the news report for one normal week totalled 2,562,715 words, exclusive of the figures of the bond and stock market which alone fill an average of 12 columns daily in the larger newspapers. In that week the news came from 1850 different cities and towns throughout the world, and consisted of 17,323 separate items. No single newspaper received all of this news.

ONE of the most important functions of The Associated Press is to furnish the member papers with financial news. The quotations are received from the N. Y. Stock Exchange on the new high-speed tickers but other exchanges still use the old style ticker. Each tabulator has a group of stocks to look after and as he notes the changes he prepares for transmission prior to the close of the market. Later changes are made so that the metropolitan papers can be on the street a few minutes after the market closes. This is a great feat involving supreme accuracy. The changes are sent with code figures which make all clear to the compositor.

A "feature service" provides special articles and matrices of pictures so that stereotypes may be cast in the home newspaper office to make printing plates. Newspapers often have no photo-engraving plants to call on. This service has been established only four and a half years, but is now used by over 1000 member papers.

The Associated Press is a very wide distributor of photographs. Some of the larger papers receive 250 a week. All possible means of communication are used; airplanes, steamships, automobiles, fast trains, even telephone circuits which transmit pictures by wire.

Newsphoto distribution rack indicates when pictures are to be dispatched by train or air mail to members. New York papers get pictures eight times daily

OUR POINT OF VIEW

Cause or Effect?

IN a recent appeal to the scientists of the world, Professor Albert Einstein asked them to discontinue their research for the creation of new instruments of war. "Those who believe that the danger of war is past," he is quoted as saying, "are living in a fool's paradise. We face today a militarism far more powerful and destructive than that which brought on the World War disaster."

We shall, for the moment, pass over the apparent inconsistency between Professor Einstein's request and his explanation (quoted) of the reasons for it, and will agree, in part, with him. The signs do point to the danger of wars to come; there is evidence of the existence of more selfish, Nietzschean nationalisms than ever before felt a superiority over and sought to dominate other nations. Professor Einstein is, however, a world-famed physicist, not a sociologist; and he apparently does not accept the fact that this "militarism," this contempt or hatred for other nations is in men's minds, not in their accumulated trappings of war. Those who desire war, who see it as their destiny, who, like Alexander, weep when they can not tread the warpath of the conqueror, will continue to rattle their sharpened sabers. Others then, peacefully inclined but chary nevertheless, are forced to perfect their engines of destruction simply in self defense. The man who goes out in a boat does not *expect* to drown but he carries a life preserver just the same; and the mere fact that he has it does not bring on a storm!

We hope some day to see the abolition of war for all time, but we know that only a change in human nature will make this wish come true. Armament is the effect, not the cause of the warlike aspect of the world; and while disarmament is a laudable aim, it must have a reasonable minimal limit until national animosities have ceased to exist and the long-heralded and hoped-for brotherhood of man becomes a fact.

Fundamentals

IN our highly mechanized civilization, it is difficult for the average person to get more than a general idea of how most of the products of man's knowledge, ingenuity, and industry have been evolved or the processes involved in making them. He may know these products in his own field thoroughly and some of those in allied lines, but about others that have a vital place in our scheme of things he can only read tame, abbreviated accounts.

Aviation is one modern industry which appeals to millions but which, because of its characteristic rapidity of development, possesses many mystifying features. To those who are interested simply because of the fascination of the subject or who wish to study the secrets of the airplane's aerodynamic efficiency or of its construction, we recommend a visit to the Museum of Science and Industry when in New York City.

This museum's aviation room, which is to be formally opened to the public this fall, is the first of its kind in this country. There the visitor may push buttons and operate instruments that show the action of air currents around aerofoils and other shapes, and on the Flettner rotor; may operate devices that teach the principles of aviation instruments; may study structural details of various airplanes and aviation engines; may, in fact, seat himself in the cockpit of a pivoted instruction ship and actually turn and dive and zoom as he handles the controls.

The value of such a museum to the layman, the engineer, the industrialist, and particularly to the coming generation of aviation experts—those young students who want "to see the wheels go 'round"—is great indeed. In no commercial organization and in but few museums of the world can anything comparable to this exhibition be seen; and the officials of the museum who are responsible for it are to be highly complimented on the success of their labors.

Rolling Down to Rio

GONE are those romantic days when spread-sailed clipper ships, braving coastal storms and the hurricanes of the old Spanish Main, threaded their way through jewelled isles of the West Indies and went "rolling down to Rio." But the romance that very nearly disappeared with them and the advent of the steamer, has come back in the form of great spread-winged argosies that lift into cerulean skies and jump into and beyond the glittering tropics in much less time than either the clipper or the steamer could make the trip.

On page 234 are given a few of the highlights behind the reason why America holds an outstanding position in the field of international air transport. Representing a community of interests on the part of industry, commerce, finance, and the government of the United States, Pan American Airways is an American institution today—the "aerial merchant marine" of the United States—accomplishing in the skyways the same important mission that our merchantmen are furthering on the high seas.

In less than four years, this international air transport system—today larger by a wide margin than the great subsidized international air units of Europe: Imperial Airways, of Great Britain; Deutsche Lufthansa, of Germany; or Aeropostale, the continent-girdling system of France—has established an impressive record. More than 80,000 passengers, at a rate equivalent to more than 45 percent of the persons carried each month on the 26 domestic air lines in this country combined, have traveled over the air routes to the West Indies, and to Central and South America. And what is perhaps more important to the average person, insurance statistics show that the traveler is safer in a Pan American plane than he is in a railroad train or his own automobile.

Drug Control

IN July. 28 out of 57 delegations of nations signed at Geneva a convention for the limitation of narcotic drug manufacture. This is the first forward step in the difficult problem of drug control that has been made for many years.

The drug traffic has increased at a most alarming rate during recent years, especially in the United States. The legitimate needs of the world for narcotics amount approximately to the low figure of eight or ten tons annually. And yet production runs to several hundred tons! What is still more shameful is that America is by far the largest user of narcotics!

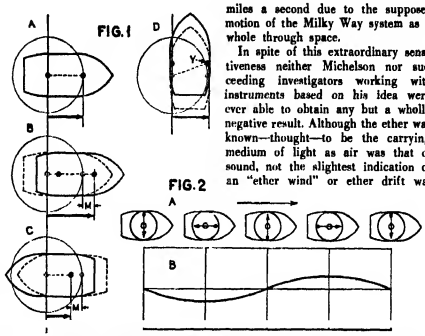
Drug addiction is not a vice; it is a disease, a habit acquired unwittingly in many cases but more often through the wiles and trickery of the dope-peddler than whom there is no lower animal on earth. If the agreement to limit narcotic drug manufacture is strictly adhered to, as is confidently expected, fewer lives will be ruined by the deadly powders. If they are not made in such large quantities as heretofore, the drug-peddler can not sell them, for unlike alcoholic beverages, narcotic drugs may not be synthesized; there can be no such thing as bootleg narcotics except in comparatively negligible quantities.

MORE HARD LUCK FOR THE ETHER

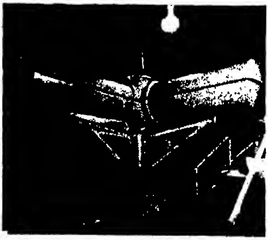
By HENRY SIMON
Jena, Germany

IS there an ether, or is there not? Scientific opinion on this great question is still divided. It is answered in the negative by the adherents of the Einstein theory. Another and a smaller group of leaders of scientific thought answer it in the affirmative; as indeed it had been answered by scientists generally until the end of the 19th Century. It was the famous "ether drift" experiment, carried out by Michelson in 1887, that first raised doubts as to the existence of the ether. The findings of that experiment were later to become the foundation for the theory of relativity.

Michelson reasoned that if the earth is moving through an ether, and if that ether is the carrier of light, then a light signal sent in the direction of motion through the ether must travel slower than a signal sent in the opposite direction. A rough picture of his idea may be had by imagining a ship a. . —, — which a sound signal is sent from one point of the deck to another. On looking at A and B, Figure 1, it will be plain that the time of the signal will be lengthened or shortened by the distance M, according to whether the signal is sent with or opposite to the direction of motion.



Differences in the time of a sound signal on a ship at sea, an analogy with the ether drift experiment. The spreading sound wave is indicated by a circle



The Joos-Zeiss interferometer recently used

If the signal were sent crosswise of the ship over the same distance, as at D, then evidently there would be practically no difference, although the observer would have to be stationed at Y because of the lateral drift.

Let us go a step further and imagine the whole apparatus, sending station, observer, and all, placed on a platform which was set slowly revolving as the ship proceeded, as at A in Figure 2. Then evidently there would be a gradual periodic transition in the length of time taken by the signal from normal to below normal, back to normal, and to above normal. This transition might be graphically expressed for each revolution of the platform in the shape of a curve something like the one in B.

It was exactly an effect on this order, obtained with an apparatus designed on the broad principles of the ship analogy just suggested bu using light instead of sound and carried on the earth as it rushes through space instead of on a ship plowing through the ocean, that Michelson strove for in his classic experiment. How he overcame the difficulty of measuring time differences, which at the speed of light of 186,000 miles per second would run into billionths of a second, by transferring the problem to the realm of interferometry, will be explained further on. Suffice it to say now that his final instrument was so sensitive that it would positively reveal a light velocity difference of only one mile a second as against a conceivable maximum difference of 18 miles a second due to the earth's motion around the sun, and of several hundred miles a second due to the supposed motion of the Milky Way system as a whole through space.

In spite of this extraordinary sensitiveness neither Michelson nor succeeding investigators working with instruments based on his idea were ever able to obtain any but a wholly negative result. Although the ether was known—thought—to be the carrying medium of light as air was that of sound, not the slightest indication of an "ether wind" or ether drift was ever dis·nible. Though this result had not bee xpected, it was fully as important from the standpoint of science as a positive result would have been, for it clearly indicated some vital fault in previously accepted reasoning. One obvious conclusion to which it might be conceived to point was that the reason for the absence of the ether drift was that no ether exists. It is this assumption, indeed, which has become ·f the corner stones of relativity.[1]

AT any rate, after many repetitions of the experiment, both sides had accepted the null result as a fact, and each had drawn its conclusions accordingly. A tremendous stir was therefore created when in 1925, Miller suddenly reported that in again repeating the experiment with a new apparatus, he had noted what seemed to be an undeniable ether-drift effect. If true, then this dis-

[1]Strictly speaking, Einstein never did, as is often said, "throw out the ether." As an ether was not a part of his system he never brought one in.—*Editor.*

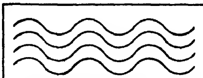


FIG. 4

Diagram illustrating light waves

covery would have a momentous bearing on one of the great riddles of the universe. The cause of the ether proponents would be strengthened and, by the same token, that of the relativists would suffer correspondingly by the collapse of one of their principal tenets.

IT was because of Miller's experiment and the questions it raised, that an extraordinary effort to settle the problem was undertaken by the University of Jena with the aid of the Zeiss Works, renowned builders of optical and astronomical equipment. The purpose of the instigator of the idea, Professor G. Joos of the chair of theoretical physics of the University of Jena, was to raise the sensitiveness of the new apparatus beyond all previous means; also to cause it to record its findings automatically in permanent form, ready for any one to check them by the instrument's own handwriting, instead of relying upon subjective readings as in all previous instruments.

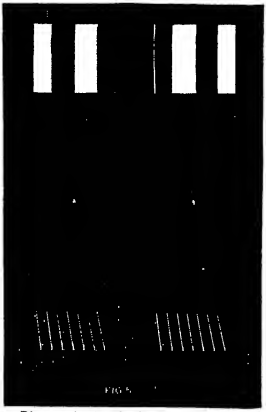


Diagram showing the formation of interference bands. This may be passed over hurriedly by the casual reader but ten minutes close study and tracing of lines will repay the reader who wishes a clear understanding of the subject

A general view of the interferometer is seen in Figure 3. All former ether appa-

son's design, having a body of marble or steel, which bore the optical parts and floated in a bath of mercury in which it was slowly rotated around its axis. The new interferometer differs in this as in almost every other detail from all previous forms of apparatus, though it is like them in its essential principle. It will be of interest briefly to review this principle and its appli- ... the purpose under discussion.

A stream of light issuing from any source may be regarded as a bundle ... vibrating in exact unison somewhat as indicated in Figure 4. No matter whether the distance traversed by these rays is an inch or a million miles, they will normally continue vibrating in exact time.

Under some conditions, however, it may happen that some of these component rays are thrown "out of step." This takes place, for example, when two plane surfaces, of which the upper one is transparent, are placed nearly parallel to each other, and illuminated by monochromatic light, as in Figure 5. Any incoming ray R is partially reflected by the upper mirror surface A by way of r_1. The remaining light passes through the thin semi-transparent coating of silver to surface B, whence it is reflected in a form of a second wave train r_2. It will be evident that r_2 has to travel over a path longer than that of r_1 by twice the distance X between the reflecting surfaces. If the difference contains a half wavelength, then on coming together at D the wave crests of the two trains will collide, motion will destroy motion, and darkness will be the result. With the two mirroring surfaces at a small angle as shown, a pattern like that at E will be produced, with dark bands marking the indicated locations. By studying Figure 5, it will be seen that as the distance

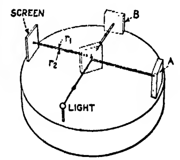


FIG.6

A schematic representation of the Michelson ether drift interferometer. Compare with diagram below

between the reflecting surfaces is varied by any amount whatever, the dark bands will travel over the surface of screen E in one direction or the other, reassuming their original arrangement each time the distance X has been increased or decreased by half a wavelength.

The length of light waves differs for different colors of light, but remains an exact constant under like conditions. For green light, for example, it is about 0.00002 of an inch. To ... ment of the bands equal to the distance between them, therefore, X must be varied by 0.00002 ÷ 2, or 0.00001 of an inch. The fixed distance L between bands is usually adjusted to something like an eighth of an inch by altering the angle between the two surfaces. With the aid of special instruments, a shift in position of the thousandth part of this distance can be detected, equivalent to a variation of distance X by 0.00001 ÷ 1000, or one-hundred-millionth of an inch.

In the diagram of the ether drift interferometer of Figure 6, the only real difference from the case portrayed in Figure 5 is that the reflecting surfaces

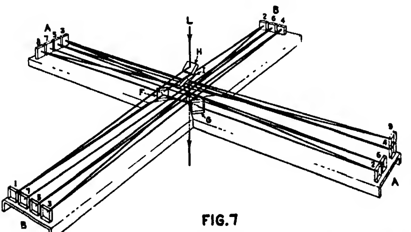
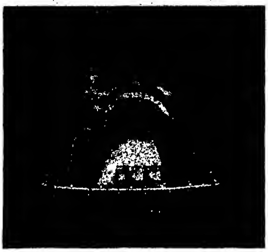


Diagram of light path in the Joos-Zeiss interferometer. The ray coming from inclined mirror H over I is split into halves by half-silvered mirror F. The path taken is shown by the numbers. From I the path leads to a moving plate



Interferometer casing opened, showing suspension of the fused quartz cross from springs

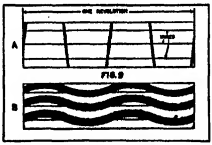
are two widely separated mirrors while the light-dividing function of glass plate A of Figure 5 is delegated to a separate thinly or "half" silvered glass plate at the center which transmits a portion of the light and reflects the other portion at right angles. Otherwise, the interference phenomena arise in exactly the same way between the respective rays, light areas and dark bands being produced as the two wave trains return to the screen shown at the left in the same or opposite conditions of phase.[2]

If the arrangement of Figure 6 is now imagined as being rotated around a central perpendicular axis, then we have an apparatus analogous to that of the sound-signal experiment made on the boats. Assuming that there were an ether drift, then a point denoting successive positions of each band during each revolution would produce a sinusoidal curve similar to the suppositious one of Figure 2, though double because the light rays run in two directions of the platform instead of one.

In the ether drift interferometer, this light path is lengthened by reflecting the light back and forth several times in each direction from a succession of mirrors. The total length of this path is nearly 70 feet, a distance in which the discoverable shift of a fractional wavelength represents nearly the one hundred billionth part. Some conception of what this means will be had from the statement that if it were possible to measure the 240,000-mile distance to the moon with an equal degree of accuracy, then a variation in this distance of half an inch could be positively detected by measurement, while a difference of ten feet would appear as a coarse error readily noticeable even with the naked eye.

The optical carrier which bears this system and constitutes the most important part of the interferometer is best seen from the sketch of Figure 7. It comprises a flat quartz cross 15 feet in width in either direction and composed of four wings of shallow channel section. The production of these large quartz parts in itself was a feat that would have been impossible a few short years ago. The reason quartz was decided upon is its extremely low coefficient of expansion, combined with freedom from the effects of magnetic influences exercised by the earth, such as might cause disturbance if invar metal were used.

The cross thus produced is highly delicate and without adequate support would be mechanically a fairly limber object. Yet any deflection sufficient to disaline the mirrors by even a millionth of an inch—such as would arise by bending the cross over its length by the thousandth part of a human hair



The expected effect, supposing there really were an ether drift

—would render the whole instrument unfit for its purpose by causing a shift of bands exceeding the possible ether drift effect. These difficulties are avoided by suspending the cross from a total of some 700 piano wire springs, in the manner seen faintly in Figure 8.

The optical arrangement on the cross consists of 17 mirrors, one light-dividing plate F, Figure 7, and one compensating plate. To this system a ray of light is admitted from a mercury lamp L (shown also in Figure 8) placed above the instrument over inclined mirror H, and, after being split at F and running its course over mirror groups A-A, B-B, is reflected down and through an objective below the apparatus by a second inclined mirror I. Each mirror on the cross has a delicate screw adjustment for purposes of alinement. One mirror has a frame with three fine horizontal wires in front, which appear in the photographic record as fixed lines, and serve for checking the position of the interference bands on the mirror.

The light metal casing in which the cross is carried can be hermetically sealed. Each arm is braced underneath against the hollow column on which the casing with the cross is revolved around its tubular pivot. The instrument is revolved once in ten minutes by a simple round belt drive, the belt being kept slack to prevent the transmission of vibration.

A complex mechanism as well as a delicate one is the camera drive. This comprises a telescope driving clock at one end, and a photographic plate-holder at the other. As the clock revolves, the plate is slowly fed along under a fine cross slit in the diaphragm of the objective. Through this a hair-like section of the interference picture is photographed (Figure 10) on the moving plate.

After two years of concentrated planning, construction, and adjustment, it took but a few days' and nights' running of the instrument to obtain its answer. Briefly that answer is again no trace of an ether drift effect.

To the layman, it will naturally be of interest to know how the photographic records would look, supposing there were an ether drift. Such a picture is shown in Figure 9. The maximum, 38 bands, could of course be obtained only if the plane of the cross in the instrument coincided with the motion which the earth, as a member of the Milky Way system, executes through space. Both sides of the argument agree that a full effect might not result in any case, because of the possibility that the ether might be "entrained" or dragged along to some extent by large bodies of matter as they rushed through it. Even after making every allowance for this entrainment, however, if there were an ether, some measurable effect similar to B, Figure 9, should remain.

As it was, the uncurved photographic records of Figure 10 clearly demonstrate that an ether-drift effect, if there were any, could not be over one mile per second—so low a fraction of the known 18-mile-per-second velocity of the earth around the sun that probably no explanation will ever reconcile it with the properties of all-pervasiveness and high density which were assigned to the ether.

The effect actually obtained was straight lines. Exit the ether, a figment of the imagination

[2]Because, if the ether drifted past the earth as the earth moved through space, the light waves would be carried along with it, and would be carried faster in the direction of the drift or "wind" than at right angles to it; as in Figure 6 when one or the other of the two beams is turned in the appropriate direction.—*Editor.*

TUNGSTEN BOWS TO THE PLATING BATH

TUNGSTEN is no longer the "rare material" it was thought to be at one time. Large deposits of tungsten-bearing ore occur in different parts of the world and the processes of reduction have been simplified and improved. The industrial application of this metal with its alloys and compounds is constantly being enlarged. Dr. Colin G. Fink, head of the division of electro-chemistry, Columbia University, says: "It is considered today one of the 'key metals' of civilization. On the basis of annual tonnages the world output of tungsten is less than one third that of nickel, and only about ten-fold that of gold. However, due to such fundamentally economic products as tungsten alloy steel and tungsten filament lamps, tungsten today occupies fifth place among the first ten essential metals of modern civilization. . . . The outstanding valuable chemical and physical properties of the metal and its alloys and compounds, such as, for example, the metal's resistance to severe corrosive agents, including hydrochloric acid, the extreme hardness, second only to the diamond, that can be brought about by the addition of small percentages of other elements to the tungsten, ensure for the metal, its alloys and compounds, a far-reaching further development. . . . To be deprived of tungsten would cripple a dozen industries, including the lighting industry, the steel industry, and radio."

Professor Fink is the originator of the ductile tungsten lamp filament which is used throughout the world. Emboldened by his success with chromium plating he now adds tungsten plating to his achievements in the realm of electro-chemistry.

International Newsreel

Dr. Colin G. Fink at Columbia University where he has made important discoveries

The first attempts to plate tungsten were made by a German chemist, Zettnow in 1867. He used a bath of molten sodium tungsten, and succeeded in obtaining a tungsten oxide by electrolysis, but failed to make pure tungsten.

Dr. Fink has shown the writer some remarkable specimens of the results obtained by tungsten plating and certainly the dream of over 60 years has been realized. The product has a beautiful color, whiter than silver. When we have household utensils made of aluminum and plated with tungsten the work of the housewife will be curtailed, for the luster is imperishable. Dr. Fink considers that cutting tools which have been plated with tungsten will prove of the greatest possible use and value.

Tungsten is a product of the electric furnace. Our illustration shows the swaging process

"A comparison of tungsten with other metals," said Professor Fink, "shows the desirability of a tungsten coating. Cadmium, silver, and nickel are all duller and have a much lower melting point. Chromium is almost equally bright, but it melts at a much lower temperature, and is soluble in hydrochloric acid."

Professor Fink's process involves the passing of an electric current through an aqueous solution of sodium tungstate. Deposits of metallic tungsten are successfully produced on a variety of metals, including brass, copper, and iron; also carbon. The tungsten deposit is smooth, hard, and coherent, having a high luster.

A piece of brass which Professor Fink had plated with a tungsten alloy was not noticeably attacked by hydrochloric acid in a week. A coating of any other common metal of equal thickness, Professor Fink pointed out, would have had a life of seconds, rather than of hours, under similar conditions.

The problem which was set out to be solved was that of developing a process for the electro-deposition of metallic tungsten from aqueous solutions which would be adaptable for use on a commercial scale. Electroplated metallic coatings are usually desired because of the decorative value of the plated metal, or because of an increased resistance to corrosion.

Ferberite from Colorado is a source of tungsten. White areas are quartz

Dr. Fink says: "The sodium carbonate solution to which tungstic acid has been added is in most respects a good plating bath. It is easily made up; it is neither poisonous nor corrosive. The salts can be readily obtained on the market and in a pure condition; the tungsten deposit produced is clean and bright; no addition agent, such as glue is necessary." He has also been successful in depositing tungsten alloys.

Dr. Fink is to be congratulated on the successful outcome of a series of experiments extending over a quarter of a century. Such patient pioneers are one of the assets of our country.

THE SUN AN ATOM BUILDER—A NEW THEORY

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE sun—and all the stars as well—are all tremendous heat engines, drawing energy from some internal source, transmitting it into heat and radiating this out into the depths of space where it is lost, not merely to our knowledge but almost to our powers of speculation. The rate at which this process is proceeding is so great that it is hard to realize, even for a mind trained in handling large numbers. To express it in ordinary engineering units is hopeless. We can do better if we recall that, according to the principles of relativity, heat, like other forms of energy, has mass and might imaginably be weighed.[1] It is perfectly reasonable to speak of a pound of heat, but a pound of heat is an enormous amount—enough to convert 30,000,000 tons of cold rock into molten incandescent lava if it could be fully utilized, or to supply 2,000,000 horsepower for almost a year.

Measured in these huge units we find that the sun is sending out 4,200,000 tons of heat every second, and it has been shining at substantially this rate not merely for the few thousand years of history but for the thousand million years or more of geologic time. What can be the store upon which it draws if after this incredible prodigality its resources show no sign of depletion?

IT has long been known that no ordinary chemical action could produce more than a few millionths of the amount of energy required, and even the gravitational energy liberated by the gradual shrinkage of the sun's mass accounts for only a few percent. Something must be happening to the very substance of the sun—the atoms of which it is composed—so that their aggregate mass is diminishing at the rate of 4,200,000 tons every second. Either some atoms are disappearing completely or a greater number are undergoing some change which diminishes the combined weight.

Both processes are imaginable within the scheme of modern physics. Perhaps under exceptional circumstances a pair of the positive and negative electrical charges of which atoms are built up—a proton and an electron—may meet and annihilate one another, leaving nothing but a spark of outgoing radiation carrying the energy represented by the combined masses which have vanished, and the stars may be kept shining by actual consumption of their substances. Or again, the process may be one of building and not of destruction of atoms. Hydrogen, the lightest and simplest of atoms, consists of one proton and one electron. The heavier atoms have two or more electrons circulating outside a nucleus, which doubtless contains both protons and electrons locked together in some way not yet fully understood. The total number of electrons inside and outside the nucleus equals that of the protons in the latter, so that we might imagine the complex atom to be built up out of a number of atoms of hydrogen. But the weight of the heavier atom is in all cases less than that of the corresponding number of hydrogen atoms. This indicates that in the process of formation a large amount of energy would be liberated by the "packing" of the constituents of the nucleus. This "packing defect" of mass varies a little from atom to atom, being greatest for iron and the neighboring elements, but it averages about one part in 130 of the original mass.

IF, then, we could turn one pound of hydrogen into heavier elements enough energy would be liberated to provide 100,000 horsepower for more than six weeks. If the sun were originally composed of hydrogen its gradual transmutation to other elements would provide heat enough to keep it shining at its present rate for over a hundred billion years. The complete annihilation of the sun's mass would supply the radiation for more than a hundred times as long.

It is evident, then, that if either of these processes were at work within the sun its mass and presumably also its size and brightness would have changed very little in the whole range of geological time, and it is generally believed among astrophysicists that one or both of these strange things actually does happen.

But until very recently the details have been completely obscure. We know that under ordinary circumstances atoms are very stable structures indeed. Radioactive elements, to be sure, do break down automatically, emitting amounts of energy which, though great by any ordinary reckoning, are small in comparison with that which would result from building atoms of equal weight out of hydrogen. But these elements are present in very small proportions on earth and are not abundant enough in the sun to show at all in its spectrum. Very little heat (in comparison with the amounts here under consideration) can be produced from all sources inside our planet, otherwise so much would escape to the surface that it would be red hot all over.

Most investigators therefore agree in supposing that the heat-liberating process inside the sun and the other stars goes on faster at the very high temperatures which prevail in their interiors than it would in colder matter of the same composition. It looks at first sight, though, as if this would make a star's life extremely precarious. Heat generated deep inside a star must take a long time to work out to the surface. The actual amount produced per second inside the star must be so adjusted as to balance this leakage. But suppose that by any accident the star's interior grew a tenth hotter. Heat would then be produced more rapidly, faster than it could escape. Then the inside of the star would tend to grow hotter, still more heat would be produced, and we might expect the star to end with an explosion of prodigious magnitude.

THIS would doubtless happen if the star was compelled by some supernatural force to remain at the same size. But an actual star, if the temperature and pressure increase in its interior, will expand and an expanding mass of gas tends to cool. Calculation shows that with actual conditions the cooling due to expansion would more than balance the initial heating and leave the star as a whole cooler than at the first, the excess of energy liberated being used up in expanding the star against its own gravitational attraction. This cooling would diminish the rate of production of heat and so turn off the over-supply and remove the danger of explosion. The first temporary expan-

[1]See Heyl, "The Strangest Thing in Physics," Scientific American, June, 1929.—Editor.

Last month two striking photographs taken from the Mount Wilson Observatory by the astronomer Ferdinand Ellerman were shown. At the right is another, from the same viewpoint. A hail storm is passing over Pasadena, while at the right a patch of white marks the city of Glendale, hail covered and shining in the sunlight that penetrates an opening in the clouds. Farther still, to the right of the picture, is the ocean beach line 30 miles away

sion would, however, go too far and be succeeded by a contraction, so that the star would be set into "pulsations," swelling and shrinking. The Cepheid

numerous class of stars, appear to behave in just this way.

But here another theoretical pitfall opens. It is possible that the pulsations may get out of control and become more and more violent until the star breaks up. To escape this we must assume that the increased heat production does not follow instantly upon a rise of temperature but lags long enough to allow the expansion to take place (a few hours in the case of the sun and a few weeks or months for the giant stars). Sir Arthur Eddington favors this hypothesis; Sir James Jeans disagrees and attributes the heat production inside the stars to atoms heavier than any found on earth, which decay like the radioactive elements but more slowly. No one, however, until very recently, has made even a suggestion from the side of atomic theory how any such atom-building process could actually occur. An important paper by Professor Atkinson of Rutgers, which has just appeared, makes the first attempt.

STARTING with the recent wave theory of the constitution of atoms and their nuclei, he finds that at temperatures of 10,000,000 degrees or more a flying proton may sometimes hit the nucleus of a light atom in such a way that it goes in and sticks there, producing a new atomic nucleus of greater charge and weight. By repetitions of this process and by the capture of electrons by nuclei in a corresponding manner, heavier atoms would gradually be built up. Under conditions such as might prevail in the interior of the sun an atom of helium would last on the average but a few seconds before a proton entered its nucleus and built it up into one of lithium (of atomic weight 5). Further captures of electrons and

atoms of weights 6 and 7; then atoms of beryllium, boron, and the heavier elements. By the time the process got as far as oxygen the intervals between further upbuildings would increase to many millions of years and heavier atoms would be produced very slowly.

If this was the whole story all the atoms of helium and the other light elements would soon be built up into carbon, nitrogen, and oxygen and things would come to a stop. But there is good reason to believe that one of the kinds of beryllium atoms (an isotope of atomic weight 8) is unstable, each nucleus of this sort breaking down after a considerable average interval into two helium nuclei. This affords a fresh supply of helium and the process will go on anew with a steady formation of heavier atoms from the hydrogen, which it is assumed formed originally the main part of the mass if not almost the whole, and of course with a steady liberation of the "packing energy" in the form of heat. The whole process of atomic synthesis should be very greatly speeded up with rising temperature, so that the heat production shows both the dependence on temperature and the time lag which are demanded on astronomical grounds. A further and very striking success of the theory is found in the fact that the strength of the lines in the solar spectrum indicates that lithium and beryllium are present in but small proportions, while the succeeding elements up to oxygen are more and more abundant. This is just what is predicted, for the lighter elements have such short lives before their atoms get built up into heavier ones that there should not be much of them present at any one time, while the longer lived and heavier ones up to oxygen should be increasingly abundant.

however, would not have had time to be formed in any considerable quantities in this manner, even during the whole life of the star, and it appears that some additional process of atom building not yet amenable to the theoretical discussion must be at work to produce them.

THE temperature deep in the interior of the sun which will be required to keep it going by atom building is estimated by Professor Atkinson as about 20,000,000 degrees, a value in agreement with the earlier calculations of Eddington if hydrogen is assumed to be the major constituent, as it certainly is on the sun's surface. For other stars of the "main sequence," ranging from those in Orion through Vega, Sirius, Procyon and the sun, to the faint red dwarfs, the calculated temperatures are of the same order of magnitude.

Years of further study will be needed before the full consequences of this most interesting theory have been worked out. Its present preliminary statement may be much modified, but it is a notable advance that a physical theory of the heat production within the stars has been propounded which not only explains many properties of the stars themselves but also accounts for peculiarities and the relative abundance of atoms of different kinds which have previously been entirely unexplained.

It is hardly necessary to add that in the present state of our knowledge other theories of the heat-producing process are also possible. Of one of these we hope soon to speak.—*Lowell Observatory, Flagstaff, Arizona.*

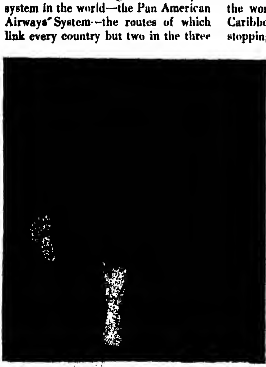
Refueling the "West Indies Air Express" at Port au Prince, Haiti, while the passengers lunch in the terminal

WINGS OVER THREE AMERICAS

By W. I. VAN DUSEN

FROM no point in the world can you travel so far or so fast, in one simple step, as you can from the busy terminals of America's international air transport system. So rapidly has the United States stretched its wings across a hemisphere, however, that few in this country realize that America has the largest air transport system in the world—the Pan American Airways System—the routes of which link every country but two in the three Americas—North, Central, and South.

From Miami, Florida, a great eastern trunk line reaches 7500 miles down through the West Indies to Port of Spain, over the Guianas, and along the south Atlantic to far-off Rio de Janeiro and Buenos Aires. South from Miami stretches the direct, continent-linking route, the longest over-seas airline in the world, striking directly across the Caribbean Sea 1350 miles to Colombia, stopping in Jamaica on the way. A third route brings Havana within two hours; a fourth reaches the Bahamas, and a fifth wings over the Yucatan Straits to Salvador.



International airliners boast a regularity of schedules that surpasses earth-bound travel

From Brownsville, Texas, the western trunk line reaches through Mexico and Central America to the Panama Canal. There it branches, one route going eastward on a transcontinental line to Trinidad, the other going south to Peru and Chile, then turning east to hurdle the four-mile-high, ice-capped peaks of the Andes to Buenos Aires.

Translated into travel terms, these routes mean that in one single day of lazy voyaging you can experience the lure of gay old Havana; look upon the mosaic fields of Cuba's sugar cane; stop off in mystic, fascinating Haiti for lunch; marvel at the oldest cathedral in the New World, at Santo Domingo; and dine in a roof garden over-looking grim old Morro Castle.

If you choose to go directly south from Florida, you land in quaint Jamaica the first night. Or, faring westward, between dawn and dusk you may explore western Cuba, pass over Yucatan Straits, gaze upon crumbling gray temples of the ancient Maya in the jungle vastness of Quintana Roo, and arrive in Salvador with time to spare for a stroll before dinner. Or, leaving from Brownsville, your first day will take you over the hills of Mexico, above ancient pyramids, through toy-like Vera Cruz, and along a range of jungle-covered mountains to Guatemala and Salvador.

THE second day on the eastern route lies along the old Spanish Main, to old Bluebeard's Castle in the Virgin Islands, to Antigua, Martinique, Guadeloupe, and then cosmopolitan Port of Spain at the cross-roads between the New World and the Old. Or, going southward from Jamaica, your airliner brings you to Colombia and over the land of the San Blas Indians to the Panama Canal.

From the west you explore the smoking range of volcanoes through Nicaragua and Costa Rica, sail between the blue Pacific and the incomparable hills

and valleys of Panama to end your day in old Panama City or in Cristobal. The third day of flying carries you through western Colombia to Ecuador, the little republic perched on the equator along the glistening coast of which the sea still washes up "pieces of eight"—some ancient pirate's treasure. Your fourth day brings you to Lima, "City of Kings" in the land of the ancient Incas, and then, on the sixth day, to Santiago, capital of Chile, nestling at the foot of the majestic Andes.

The eastward route takes you through the Guianas, tiny bits of England, Holland, and France; on down the south Atlantic, over the 200-mile mouth of the Amazon River, Brazil, and the magnificent harbor of Rio de Janeiro. Another day and you pass Santos, the world's coffee port, over southern Brazil, the purple land of Uruguay, and arrive at Montevideo, resort center of a continent. Then after a cruise up the Plata River you reach Buenos Aires, third largest city in the western hemisphere and the Paris of the Americas.


Roomy cabins, larger than Pullman compartments, provide comfort for the international air traveler

To one who has journeyed to South America aboard slow-moving steamers, or overland over rough trails in jolting motor cars, erratic trains, or on creeping burros, the change wrought by these airliners is impressive. Swift and comfortable, they sail serenely over tropic jungles, endless miles of ocean, and rugged, sky-piercing mountains, dip into fascinating ports of lands yesterday's traveler never reached, and peek into out of the way nooks and corners of this world of ours. Yet they speed you to your far-off destination in a few brief hours.

When one considers the enormous barriers its planes hurdle every day, the reason why this great international system so early achieved world leadership of air transport is obvious. Their pilots encounter conditions not encountered on all of the airlines in the United States combined. On one route their planes pass through four seasons of the year—spring in New York, summer in the West Indies, autumn in Brazil, and winter in Buenos Aires—all within seven days. On another route the airliners cross the Caribbean Sea, flying for seven hours without sight of land. On still another route, their planes fly from sea level and 90 degrees in the shade to 20,000 feet above sea level and 38 degrees below zero, and back to sea level and summer heat, all in a single hour.

While these conditions have been met, and mastered, by the planes and their pilots, obstacles just as spectacular have been conquered by the engineers on the ground. Over trackless wastes they have surveyed continent-linking air routes. Impenetrable jungle has been beaten back for the building of airports and, in one instance, a mountain was leveled to provide a landing field for these international liners of the sky. As assistants they have had small armies of natives who had never seen an ocean liner nor a locomotive. Indians have trudged with gasoline on their backs through miles of dense jungle wilderness bringing supplies to refueling points so that the passengers and mail might go through on unfailing schedules.

Nearly a third of America's aviation industry has been concentrated on this one job that demands rigid qualifications both for men and material. As these international airlines pioneered the first tri-motored airplanes to be used on airlines in the United States, so also have they encouraged development of even bigger and faster transports. Such efforts will culminate in the giant Pan American Flying Boat *S-40*—a mammoth sea-going airliner and the largest commercial airplane in the world—which will carry 40 passengers and a crew of five. This ship—for the trans-Caribbean air line and to provide Pan America with marine flying equipment to match Europe's advances—is now nearing completion at the plant of the Sikorsky Aviation Corporation, in Connecticut. Greater speeds, more comfort for passengers, shorter trips between distant terminals through fewer stops for fuel, are some of the objectives toward which new airliners are being developed.

The operation of this great network of international air lines, reared on the trails blazed by Colonel Charles A. Lindbergh, is an example of the highly organized medium of transportation the airplane represents today. From the big terminals, a fleet of more than 100 modern airliners, operating on split-second schedules and laden with passengers, mail, and express, ply between North and South America with impressive regularity. The fleet includes tri-motored airplanes for 12 and 14 passengers, twin-motored amphibions for eight persons, and giant twin-motored flying boats with luxurious accommodations for 24 and 32 passengers. In more than 20,000,000 passenger miles of flying they have completed their scheduled trips 99.67 times out of each possible 100.

In the huge storage hangars, the "round house" of the airlines, the giant airliners receive minute inspections after each flight. A corps of in-


Air passengers over Yucatan fly over crumbling temples of the ancient Maya Indians reared in the jungles many centuries ago and but recently discovered

spectors checks every inch of the planes; master mechanics go over the motors; and an expert tests each of the instruments in the pilot's cockpit. The machine is scrubbed with soap and water, and placed in perfect condition before it is accepted by the chief inspector. At periodic intervals, the motors are completely overhauled, and after a definite number of flying hours, the ship is disassembled and rebuilt.

Little of this meticulous care is ever realized by the passenger as he watches the airliners being drawn from the hangars, one every 30 minutes on some schedules. To set the wheels in motion he has simply stepped into any one of the ticket offices of the principal railway systems or a dependable travel bureau and asked for a "ticket to Buenos Aires," or to any other of the 90 ports served by the Pan American Airways System. Air fares over these international routes are approximately 10 cents per mile—25 dollars to Havana, 200 dollars to Panama, 603 dollars to Rio de Janeiro. In some instances the fares are actually less than steamer fares.

FROM any principal city in the United States, then, the passenger is routed over the associated rail systems, or on the domestic airways, by the fastest connecting schedules to Miami or Brownsville. At these, the international terminals, he is met by an aerocar and transferred directly to the airport. While he breakfasts in one of the dining rooms in the terminal station, his baggage is carefully weighed and stowed in a special compartment aboard the plane. Five minutes before scheduled departure time, a warning bell notifies the passenger his airliner is ready. A courteous, uniformed steward directs him to his seat, sees that he is comfortable, and hands him a morning paper as the plane taxies out to the end of the runway for the take-off. With his plane poised at one corner of the turf field, the pilot tests each of his motors. The Field Manager at the terminal station is also checking this last-minute inspection. When everything is satisfactory, a white light appears, the motors roar, the great ship rolls down the field and climbs easily into the air, and the passenger is on his way.

Flying over continents, passengers may have their luncheons in the air

Another phase of back-stage activities which the passenger does not see is the operation of the "block-signal" system of radio control which guards the plane over every mile of the course, just as the railroad train is directed on land.

Not a little of the effort of the operators has been to improve conditions for the passengers and the international airliners provide luxurious comfort for air travelers. Even in the tropics, the cabins of the planes are delightfully cool a thousand feet above the earth. Passing meal-hours in the air means no hardship since full course luncheons are served from the buffet.

At destinations, attendants care for the passenger's luggage, arrange it for inspection by customs officials, and the whole process is speeded up to hardly more than a minute for the air passenger. The steward, who now becomes the passenger's guide on land, is trained to supply any desired information about foreign ports, see that he is well cared for at the hotel, and arrange sightseeing trips if desired.

While the endless world these international airlines open to the tourists strikes a romantic appeal, the spectacular also rides with the air mail to these score and a half lands below the Rio Grande. Aboard the passenger transports, tons of business correspondence —speeding the tempo of trade and commerce—wing their way between the industrial centers of North America and the great commercial centers of the southern continent. Financial documents, on the wing, save 15 days interest between southern capitals and New York; transportation of orders, sales reports, plans, blue prints, construction bids, deeds, commercial instruments and the like by plane saves weeks over the fastest previous transport time.

WITH the recently established international air express service in operation, export merchandise has likewise taken wings through the Americas. Coffee samples from Brazil and automobile parts from Michigan; assay ore from Chile and radio tubes from New Jersey; diamonds from British Guiana and advertising literature from New York—these and a thousand other items pass each other along the highways of the sky, each on its own important mission for the furtherance of inter-American trade and commerce. For a dollar and fifty cents a pound the Kansas manufacturer can speed his samples into Rio to beat his European rival to a keenly competitive market by a full week. The air express rates range from one dollar and fifty cents a pound to Rio de Janeiro, one dollar a pound to Panama, down to 25 cents a pound to Havana.

In six weeks, while the tourist may cover countries that would take him a full year to visit by any means other than the airplane, the business executive can survey, and do business in, 20 different countries with ample time for conferences in the larger cities. The same trip, with similar stop-overs, would require more than 16 months of steamer travel and twice the expenditure of money for transportation.

No one could mistake "Sugar Loaf" Mountain in the harbor at Rio de Janeiro, an impressive sight which greets the aerial traveler to eastern South America

SCIENCE LENDS A HAND TO THE RED CROSS

WHILE science, that essential factor in the advancement of civilization, can be held partially accountable for some forms of disaster, its application, likewise, can be credited with minimizing distress when calamities occur. Its progress has been marked by an increase of casualties in warfare, mine explosions, aviation, and so on, but its toll has been many times offset by its value to mankind. That fact is boldly in evidence in reviewing disaster reports and other activities of the American Red Cross, an organization which is constantly applying science in the prevention and relief of human suffering.

This year marks the fiftieth anniversary of the Red Cross in this country. In tracing that organization's history, we get a perspective of numerous scientific discoveries that are beneficial in disaster relief work, and life-saving and first aid services.

Contrast, for example, the facilities for transportation and communication existing 50 years ago to those in use today. Consider the forward strides medicine has taken in the last half-century. Only in that way can the generous contribution of science to Red Cross relief operations be fully realized.

IN the relief agency's infancy it often required many days for relief workers to reach the scene of disasters occurring long distances from National Headquarters. Since that time man has, to some extent, conquered distance. Now, news of a disaster is flashed across the nation and Red Cross relief arrives by airplane or train in one third the former traveling time. Instantaneous communication and rapid travel have resulted in saving the lives of thousands injured in many disasters. Modern methods have made it possible to save hours when hours count the most. In no other way is this more strikingly shown than in the speedy delivery of antitoxins by air which often prevents the spread of disease in disaster-ridden sections.

Many of the dangers in water sports have been removed by the application of scientific methods by the Red Cross life saving service. The society's first aid service also relies on science in its teaching of artificial respiration, emergency treatment, sanitation, and other health measures.

The first American Red Cross came into being May 21, 1881, when a group of prominent men and women gathered in Washington, D. C., at the home of Miss Clara Barton, widely known for her volunteer work during the Civil War. The meeting was an effort to secure this government's approval of the Treaty of Geneva of 1864, when delegates of 12 nations met and created the first international Red Cross organization. At the Washington meeting, Miss Barton was elected the first president of the young American society. In less than one year from the date of that meeting, March 1, 1882, during the administration of President Arthur, the United States formally adhered to the Treaty of Geneva, which guaranteed protection of wounded in battle and provided a neutral flag for doctors, nurses, and hospitals during warfare.

Twenty-five years later, in 1905, Congress issued a charter to the American Red Cross. Miss Mabel T. Boardman, President Roosevelt, and Secretary of War Taft were largely responsible for the Congressional Charter. Miss Boardman still is secretary of the organization. In the Congressional Charter of 1905, the powers of the American Red Cross were broadened to include duties in peace-times, such as disaster relief, health and safety work, and service to members of the nation's armed forces. Nearly all Red Cross societies of the world now include peace-time work as well as service during warfare.

At the age of 83 years, Clara Barton, who had headed the American Red Cross for 23 years, resigned. She had seen her goal reached, her efforts realized, and termed her retirement, "laying down her heavy burdens."

The American Red Cross today has 16,200 chapters and branches. Membership has exceeded 4,000,000 annually for the last several years, with more than 7,000,000 boys and girls of school age enrolled in the Junior Red Cross.

John Barton Payne, American Red Cross chairman, also is the chairman of the board of governors of the League of Red Cross Societies which was created after the World War.

OBSERVANCE of the fiftieth anniversary was begun in Washington on the evening of May 21. President Hoover, who is president of the American Red Cross, was the principal speaker. Other addresses were delivered by Chairman Payne, who has headed the society for 10 years; Judge Max Huber of Switzerland, head of the International Committee of the Red Cross; and Miss Boardman, American Red Cross secretary.

The greatest peace-time emergency in the history of the nation was handled by the Red Cross early in 1931. That disaster was the recent drought which affected more than a score of southern states. At the peak of the relief work more than 2,000,000 drought sufferers were receiving assistance in some form from the Red Cross. Prior to the drought, the relief agency's biggest assignment was the Mississippi flood of 1927 which left several hundred thousand persons dependent upon Red Cross aid. A few decades ago no society in the world would have tackled such difficult relief jobs. But science has contributed generously to Red Cross operations. With its aid, the Red Cross has completed every task it ever undertook in its 50 years of service.

Courtesy The American Red Cross

American officers and soldiers watching the effects of blasting to stop the progress of fire following the recent disastrous earthquake in Nicaragua

NEW PAINTS FROM SYNTHETIC RESINS

By D. H. KILLEFFER

WHEN Mother Nature put oil in the seed of the flax plant and gave trees the power to heal their own wounds with balsam, the fickle old dame was probably not planning either of these things for use in the manufacture of paint and varnish. Fortunately, they chanced to be good for such purposes and for a great many centuries they have served very well, better at least than anything else. Better they were until, be it noted, just a little more than a decade ago when things began to happen in paint manufacturing circles.

Many fundamental changes have recently been revolutionizing the industry of paint and varnish, and now the development of new synthetic resins to replace natural ones in varnish gives new values to protective coatings. From time immemorial varnish has been made by dissolving natural resins in hot drying oils. The result has yielded a coating of great beauty and value, but it has not met every requirement. The effect of weather on varnishes has been particularly detrimental and few coatings have possessed both beauty and permanence under out-of-door conditions. In interior work such coatings have been much more satisfactory, but ordinary cleaning has materially shortened their lives because soap destroys them.

TO get the story of this newest development straight, one must get something of the background of the synthetic resin industry. Perhaps it is unfair to go back so far, but synthetic resins came into being as a result of a series of failures. First, there was the effort to make a super-disinfectant by combining formaldehyde and phenol (carbolic acid) which resulted instead in a gummy mess fit only for the waste can. Later this failure was resurrected and an attempt made to convert it into a substitute for shellac. This, too, failed for instead of being a tractable, fusible, soluble resin, the product was none of these. On the other hand, its very drawbacks became advantages when properly applied, and thus the now important business of synthetic plastics, of which the most familiar is Bakelite, came into being.

The fact that these resins possess the inherent characteristics of being hard, infusible, resistant to most chemical agents, and generally insoluble, led to the natural conclusion that if they could be incorporated in a varnish they might impart some of these desirable qualities to it. The problem of persuading them into a varnish mixture was a poser and for many years the only method of utilizing these valuable properties was by the use of a baked-on enamel or varnish which had a very limited field of usefulness. Imagine baking the finish on a house or a steamship!

A group of panels under test coated with various paints and exposed to sun and salt water in Florida

Recently, however, ways have been found of so modifying the resin that it is soluble in china wood oil, for example. This combination yields a varnish similar in all respects to ordinary varnishes but possessing greater durability, hardness, elasticity, resistance to washing, and so on. Not only does the new type varnish possess these valuable qualities, but it can be made to dry hard for a second coat in a time comparable with that required by lacquers.

The following points about the new varnishes are of considerable importance:

It is applied and handled in just the same way as ordinary varnishes. No special methods are required. Varnish made with synthetic resins is quite waterproof. The lady pouring hot water on the dining-room table in the advertisements has sufficiently impressed us all with the importance of this property. As a matter of fact, the coating stripped from a plate of glass and properly dried can be made into a bag both strong enough and tight enough to hold a pint of water for a week or more without leakage. This property is especially important since one of the essential requirements of paint and varnish is protection of the material beneath from the weather. It is practicable to use a varnish of this new type on boats or other woodwork that is continually in contact with water, thus preventing the wood from becoming waterlogged.

Ultra-violet light is one of the most potent agencies in the destruction of protective coating films and the fact that the new synthetic phenolic resins will not allow it to pass greatly prolongs the life of varnishes made with them when exposed to the sunlight. It seems that ultra-violet light greatly accelerates the destruction of paint films transparent to it by increasing in some way the activity of the oxygen in the air with which they are in contact.

SINCE this new type of varnish is resistant to water, it is also highly resistant to the action of any destructive agencies dissolved in water. For example, ordinary floor coverings such as linoleum are likely to be seriously damaged if the charwoman who is washing them stops in the midst of her task to gossip with the elevator man. The protection of such a floor covering by a quick drying varnish of this kind will prevent any damage to the floor even though the cleaning solution be left on it for several hours instead of minutes, as in the example cited.

Already reference has been made to the flexibility of the coating. This is an extremely important point as most varnishes of high luster made in the ordinary way from natural materials are relatively brittle. The combination of brilliance and flexibility found in the new varnishes makes them equally applicable to wood or metal for indoor or outdoor use.

One of the most striking peculiarities of the new varnishes is their resistance to damage by marine growths, such as barnacles, seaweed, and so on. An ordinary finished surface is quickly attacked and destroyed by these agencies, but it has been shown by severe exposure tests between high and low water on the

Florida coast that phenolic resin varnishes retain their luster and resist the destructive action of growths for as long as a year.

Many of the recent industrial innovations have required that entirely new industries be set up to carry them out. This one is unique in this respect. The new resins are being produced by an established manufacturer of phenolic resins, while the varnishes are being made by established varnish makers in equipment to which they are already accustomed. They are applied in the same way as other oil varnishes and may be used with similar well known limitations as the vehicle for grinding pigmented paints. It is hardly fair to suggest that the new varnishes are a cure for all ills, but certainly they represent an important advance in the paint and varnish industry.

Data on eight Varnishes, each containing 200 parts China Wood Oil and 100 parts total resin, the resin content consisting of varying proportions of Bakelite Synthetic Resin and Ester Gum								
Sample No.	1	2	3	4	5	6	7	8
% Bakelite XR-254	100	75	50	25	10	5	2	0
% Ester Gum	0	25	50	75	90	95	98	100
Drying Time	1 hr.	1¼ hrs.	1½ hrs.	2¾ hrs.	3½ hrs.	5 hrs.	6¾ hrs.	7½ hrs.
Hardness—8 hrs.	40	54	57	33	19	17	18	16
Hardness—24 hrs.	157	139	125	114	111	130		129
Hardness—72 hrs.	181	164	149	139	139	152		159
Elasticity (Kauri Reduction)	145	125	110	80	70	65	60	60
Durability Rating*	10	9	8	6	4	2	1	1
Resistance to Boiling 5% Ivory Soap Solution	Unaffected after 2 hrs.	Unaffected after 2 hrs.	Slightly soft after 2 hrs.	Soft—80 min. Removed 120 min.	Soft—27 min. Removed 55 min.	Soft—22 min. Removed 44 min.	Soft—19 min. Removed 25 min.	Soft—15 min. Removed 30 min.
Resistance to 5% NaOH Solution at 70° F.	Practically unaffected after 24 hrs.	Practically unaffected after 24 hrs.	Slightly soft after 24 hrs.	Soft—24 hrs. Not removed after 24 hrs.	Soft—10 hrs. Not removed after 24 hrs.	Soft—4 hrs. Not removed after 24 hrs.	Soft—1 hr. Removed—3 hrs.	Soft—1 hr. Removed—3 hrs.
Resistance to Boiling Water—15 minutes	No whitening Film hard	No whitening Film hard	No whitening Film hard	No whitening Film hard	Slightly white Film hard	Slightly white Slightly soft	White Soft	White Soft
Resistance to Boiling Water—1 hour	No whitening Film hard	No whitening Film hard	Very slightly white Film hard	Slightly white Slightly soft	Medium white Slightly soft	White Soft	White Soft	White Soft

* Figures indicate relative freedom from checks, cracks, or other signs of failure, 10 being the best and 1 the poorest. Exposure was from June 15 to November 15 on roof at 45° angle at Bloomfield, N. J. on maple panels.

An interesting summary of results obtained with different varnishes

TO fit this new development into the economic picture, one must consider the serious changes recently wrought in the paint industry by the development of nitro-cellulose lacquers. Having their origins in the huge manufacture and use of smokeless powder during the World War, several factors contributed to the development of new uses for nitro-cellulose of which lacquers are of outstanding importance. Excess supplies of nitro-cellulose in the form of smokeless powder, multitudes of men trained in the technique of making and handling it, quantities of solvents for use with it, and a rudimentary knowledge of lacquers gained through the manufacture of dopes for airplane wings—each of these contributed to the original development of the lacquer industry.

If one considers these causative factors, it is perfectly obvious that this development from its very nature had to proceed originally outside of the established paint and varnish industry. Its growth has been rapid and the older industry has been hard put to it to keep itself abreast of affairs and prevent the new-comer from getting beyond control. The effort has been to acquire as large a part of the new business and technique as possible to prevent it from growing out of bounds.

In spite of this, oil varnishes and paints have been to an extent replaced by the more convenient lacquers, and much equipment for the manufacture and handling of the former has been rendered obsolete.

The claim of lacquers to special favor has been based on their convenience in use and now that new types of varnishes based on phenolic synthetic resins have been shown to possess not only many of the convenience values of lacquers, but at the same time other valuable qualities not found in them, the rate of obsolescence of varnish and paint manufacturing equipment is likely to be much reduced. It is too early yet to say how far the new varnishes may go in reviving and rehabilitating the older industry and it seems probable that their effect will be rather to prevent oil paint and oil varnish from giving further ground to lacquers. Like everything else lacquers have distinct limitations and also like everything else when newly introduced they have been promoted without as careful thought to these limits as should have been the case. Their greatest advantage has been their speed of drying, amounting practically to a couple of hours where the older oil varnishes sometimes required as much as a couple of days.

This handicap of slow drying oil finishes is almost, if not entirely, offset by the peculiar effect of the new synthetic resins on oils. It is possible, using them, to prepare a varnish whose drying time is barely longer than that required to evaporate out the solvent embodied in it. This is not always necessary but that it can be accomplished places such varnishes at least nearer to the lacquer class than the older, natural resin varnishes and their other valuable properties—elasticity and resistance to weather, water, alkali, and marine growths—give them a place of real importance in the field of finishes.

All in all one may look upon this latest development as of great, perhaps vital, value to paint manufacturers.

All illustrations courtesy Bakelite Corporation

Panel at left was coated with a synthetic resin varnish and exposed to salt water, air, and sunlight in the rack shown on the opposite page. In 10 months the finish was unimpaired, while that of the panel at right, coated with spar is practically ruined

Rear of panels shown at left, numbers indicating finish used. On panel 44, tenacity of film is indicated by the adherence of marine growths. On panel 26 the growths have formed and fallen off, taking the varnish with them. Because of lack of exposure, there is little difference in gloss

Courtesy Wallace and Tiernan

Even where large numbers of bathers use a swimming pool it is possible to keep the water sanitary as a whole. Some doctors believe, however, that germs from the nose and throat may reach other bathers before being killed by the germicides used

ARE SWIMMING POOLS A HEALTH MENACE?

By ORSON D. MUNN

PERHAPS you have your own private swimming pool or hope to have one. Perhaps you swim in a friend's pool. Or you may make use of a public or semi-public pool. It makes no difference where you swim—rich man's private pool, public pool, or even river, lake, ocean, or the old swimmin' hole —you are always exposed to a certain amount of risk of infection by disease germs.

SWIMMING pools have been rather severely criticized by physicians within recent years. It generally is difficult or impossible to trace a given infection definitely to a pool—one can always claim it was acquired elsewhere at about the same time. Nevertheless many infections, some of them serious, unquestionably do come from that source. For example, the swimmer—not necessarily in a pool, either, for natural bodies of water are often as badly contaminated as artificial pools—may pick up some intestinal or skin infection. He may pick up typhoid fever. Without being aware of it he may be boarded and captured by any one of a variety of staphylococci floating on or in the apparently clean water. Infections of the eye and nose are not uncommonly acquired through bathing, especially nose infections due to inadequate knowledge of correct breathing. You will derive no added satisfaction from a stub-

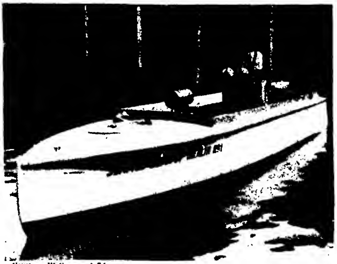
NOW that bathing pools are so rapidly becoming accessible to almost the entire population and private pools are being installed by the hundreds, the subject of swimming pool sanitation has come to the People who seldom or never have given the s definite thought are inquiring whether swimming pools are safe and sanitary or a health menace. An attempt was made to look into the question, with the outcome that no generalization could be made; some pools are sanitary and some are not. If the accompanying article sets the reader thinking and investigating it will have served its original purpose.

born infection of the middle ear because your rather expensive specialist pronounces it a case of *otitis media*. Again a persistent sinus infection may be your lot. There is no such thing as a 100 percent sanitary swim and, in fact, there never has been. Relatively speaking this applies to pools good, bad, and worse, and to natural bodies of water as well. In all there is some risk.

In large measure this is due not to the swimming pool, private or public, but to the swimmer. Man is not naturally a swimming animal; he is distinctly a land animal. In fact he even has to learn to swim, pointing to a long evolution wholly on land and in the trees. This in itself would make no difference were it not that his body carries none of the natural protections possessed by aquatic animals.

TAKE, for example, the alligator. eathing tubes are closed at the exterior of his body by special muscles. Man cannot voluntarily close his nostrils, though the boy who pinches them together on jumping feet first into the water aids nature in avoiding forcible infection. The alligator's ears have little flaps or valves which close when he submerges, and keep the water out. Our ears remain wide open—unless we plug them, which is more or less of a nuisance. Even the respiratory tract of the 'gator is closed by a trap. He is corked up as tight as a bottle, the instant he dips beneath the surface. The alligator is naturally adapted to an aquatic environment in which man, lacking the same adaptations, is handicapped. Parts of his body—nose, throat, and so on, which are not meant to be exposed to water (saliva is not the equivalent of water)—when assaulted by waterborne germs may gradually weaken, especially if the assault is long and frequent.

The aquatic mammals—seals, whales, walruses, porpoises, beavers, and so on


Courtesy Wallace and Tiernan

When small natural bodies of water are used as natatoriums they may be protected by chlorination from a "chloro-boat"

—nearly all have special apparatus for excluding the water. Man has no such provision whatever. To equal the aquatic animals he would be forced to wear tampons in his ears, a clothespin on his nose, and keep his mouth shut. This he cannot do.

No sane, practical person will urge people to stop swimming because their ancestors climbed trees instead of living half the time under water. Only a crank would insist on this. What is "indicated" in the case, is a clearer realization of the fact that there is an infection risk connected with going swimming, particularly in some artificial places, and that there is need of a reasonable amount of intelligent co-operation with nature.

It is unfair to generalize very freely about the risk of infection connected with swimming pool bathing. There are all kinds of pools. A little investigation shows that very many make some such assumptions—glittering generalities—as the following: (1) A swim in a lake or the ocean is perfectly safe and sanitary; (2) Public pools used by large numbers of people (especially if these are of all sorts) are risky; (3) Private pools are relatively safe.

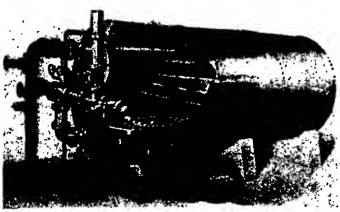
ALL three of these generalities are fully as unscientific as the notion that water is uncontaminated if it bubbles forth from the earth as a spring. First, it is quite possible to pick up some infection at a crowded beach or even in the old swimmin' hole. Secondly, germs do not distinguish between the general public on the one extreme and the social register on the other; putting aside prejudices based on class feeling, Mr. Vandercleef may be as great a menace to the other swimmers a pool as Tom, Dick, and Harry, provided he carries the right germs. Thirdly, some of the most carelessly conducted pools are privately owned (and privately mismanaged) while many of the public pools daily used by thousands are the safest risk because their management is under constant compulsion to keep them as sanitary as possible despite the large numbers who swim in them.

It is safer to use the same water in a pool—and this is done all over the country—for six months or even more, provided it is kept scientifically treated, than to use untreated water from some sources no matter how often it is renewed. By many it is believed possible to control the sanitation of a large public pool, even when used most intensively by the least intelligent, least cleanly class of persons, within the limits of risk of ordinary life. Of course there is always a risk. But too, there is always a risk in everything—in lying in bed or in walking downtown. In other words, if more than very occasional infection results from the use of swimming pools it is pretty certainly somebody's fault. At least, this point of view reflects the statements of many of the defenders of swimming pools.

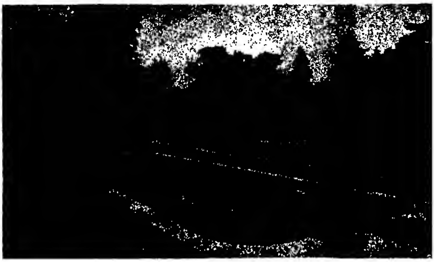
To maintain a pool in sanitary condition against heavy odds—against the expectoration of the swimmer, derived from his whole respiratory tract and certain to be heavily loaded with any germs he may carry; against uncleanliness if he has taken only a perfunctory shower bath before entering the pool; against open sores if he is willing and able to conceal them from the watchful eyes of the pool attendants; against the very common practice of urinating in the water (unconscious if not otherwise in a major proportion of all swimmers of whatever status) and against other contamination—seems almost an impossible attainment.

If he has not already done so, let the reader visit a large public pool, see thousands bathing at once, the water almost hidden by the bathers, note the wide variety of human types and realize the equally wide variety of personal cleanliness or lack of it inevitably involved, and then wonder how it is possible to avoid an epidemic. Filtering, sterilization, and constant good housekeeping are relied on to accomplish this end. In the majority of pools the water is filtered. Others employ either the "fill and draw off" system or the "continuous flow through" system. Still others combine these methods.

FOR sterilization the methods most in use are the addition of chlorine to the water, or of ozone, or the use of the ultra-violet ray. For housecleaning, various devices are used. These mechanically pick up the more conspicuous matter which lodges in the bottom of the pool. A suction cleaner called a squeegee i bottom by means of lines without the need of emptying the pool. Green scum or algae—small aquatic plants—are removed by the addition of small amounts of copper sulfate or common blue vitriol, a practice employed in city reservoirs for the same purpose. Alum coagulates fine particles suspended in the water, causing them to sink more rapidly to the bottom where they are removed by the squeegee and the suction of the outgoing water. The same chemical has long been used in city reservoirs to hasten the settling of s pended mud particles. What the bather really does is to swim in a mild solution of chemicals. It would seem that no ordinary germ could long survive in such a place.


In many pools the water, in addition to germicidal treatment, is continuously filtered through sand and gravel filter beds

Caring for a pool is a trade in itself, one requiring attendants who are capable of taking pains and actually interested in doing so. The commodity known as intelligence is also required. Unremitting diligence is demanded. Not every workingman is capable of caring for a pool. In the case of municipal pools local politics may prove as deadly a menace as the well known *bacillus coli.* This statement may be an indiscretion but, if classed as a scientific observation, it may be left standing.



A private pool. However beautiful and attractive, unless a private pool is managed scientifically it may become a menace to one's family and friends

What do the doctors say about swimming pools? They have said a great deal—perhaps fully as much as the makers of pools and pool apparatus. These two groups are not always in full agreement but doctors do not condemn the swimming pool out of hand; nor, on the other hand, do the manufacturers obscure all their dangers.

Most of the discussion by medical men has appeared in medical journals which the general reader seldom or never sees. The reader who is especially interested may search the back files of the *Journal of the American Medical Association* (Chicago). A still more special journal is the *Journal of the American Association for Promoting Hygiene in Public Baths* (New York).

A great many physicians are rather doubtful about swimming pools. Here is a statement made at a meeting of the American Medical Association by Dr. Frederick E. Hasty of Nashville, with reference to diseases of the paranasal sinuses, middle ear, and upper respiratory tract. "These infections," he says, "have become so frequent in recent years that almost every family has in one way or another been brought to grief as a result of swimming." Continuing he says, "The water in the pool during the time of swimming represents the combined washings, so to speak, of the mucous membrane of the nasal chambers and mouth of every swimmer." Further, "water in the majority of swimmers gets well into the nasal chambers, therefore carrying with it the contamination of the pool and at the same time adding to the pool whatever bacteria may be present in the particular swimmer's nose. The infections are likely transmitted from one individual to another during the swimming period *before the sterilization process has time to influence the bacterial count materially.*" (The italics are ours.)

We may place this last statement in juxtaposition to the statement previously made, that the water of a properly cared for pool is really a mild chemical bath, sterile because germs cannot survive in it. Since it takes an appreciable *length of time* to kill germs in most cases, antiseptics often being rated in value on the basis of the *time* they require to do the killing, it seems to boil down in final analysis to a question of whether it is good logic and good science to assume that bacterial tests made on water which has lain chlorinated or ozonated for many hours in a pool and which really has had time to become sterile, may be taken as assurance that disease germs spat out of the mouths and blown out of the noses of the hundreds of bathers crowded into a pool such as is shown in one of our illustrations will not remain virulent *long enough* to be picked up in that condition by the other bathers. Apparently Dr. Hasty thinks they may be picked up before they are killed, and many other physicians agree with him.

What happens, according to Dr. Hasty, is something like this: The water temporarily shrinks the mucous membranes adjacent to the openings of the sinuses, water then gets in and brings bacteria to a region where in all probability there is not a natural local resistance to the bacteria. The same shrinking causes congestion of circulation and obstructs drainage from the sinuses that have become infected. The situation is then favorable for the development of the bacteria. When the nose is next blown vigorously the infection is spread to other cavities.

THUS the swimmer now has a fine sinus infection, but when anyone ascribes it to swimming in a pool he may say it was only a coincidence. Of course, it might actually have been a coincidence. He cannot prove it was, but others cannot prove it wasn't. It is here, right between these two positions, that a lot of swimming pool dirty work (literally) gets by.

In the meantime we have some 12,000 or 13,000 swimming pools in the United States of America and the chances are we shall keep them, together with whatever germs they present us. The pools are not likely to become very bad, but they probably never will become very good, this side of Heaven and perfection.

Careful persons may, however, use the judgment nature gave them and avoid a large part of the risk of infection, without making such a bogey of swimming that it is no longer any fun.

Courtesy J. F. Whitman

The sterilizing room of a swimming pool where the germicide is ultra-violet radiation. The water passes before special lamps, and the rays kill the bacteria on which they impinge

FROM THE ARCHEOLOGIST'S NOTE BOOK

A Chinese Funereal Horse

THE Chinese horse in the collections at the Museum of Fine Arts, Boston, dates from the T'ang Period (618-907 A.D.) and was probably made originally for the tomb of an emperor. The rich green and orange glaze characteristic of T'ang pottery is enhanced in beauty by the opalescence acquired through burial. Among many known

This Chinese horse in faïence was made for the tomb of an emperor

models of horses recovered from ancient Chinese tombs this one is unique in the position of the animal. It is a cross between the Arabian and the Mongolian steed, with an exquisite Arabian head. It is two feet high.

Early Persian Inventions

SIX leaves from the famous treatise on "ingenious geometrical contrivances" compiled by al-Jazari in 1206 ›. by command and for the Urtuqid Sultan Mahmud, Malik-as-Salih, who reigned in Amida from 1200 to 1222, are in the collection of the Museum of Fine Arts, Boston. The author was an inventor and seems to have been first and foremost a craftsman and secon-

All photos courtesy Boston Museum of Fine Arts

darily an author. The importance in which this book was held in the 13th and later centuries is attested by the many copies made of it.

The original treatise, of which six leaves are in the Museum, contained articles on the construction of clocks; the construction of vessels and figures suitable for carousals; the construction of ewers and cups for bloodletting and washing; the construction of fountains in tanks, which change their form; perpetual flutes; the construction of instruments for raising water from shallow bodies of water, and from running water. The leaf shown (the sixth) represents an apparatus for raising water by animal power. Al-Jazari prides him-

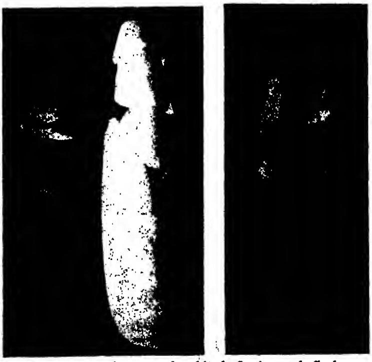
Silicate deposit was removed from vase (*left*) by refiring in kiln, releasing the beautiful design (*above*)

self that by means of this device the donkey is made to work all the time.

Difficult Restoration

THE Museum has a British Museum trained restorer of antiquities, Mr. W. J. Young. He succeeded in removing an encrustation of silicates on a fine Greek vase. He fired it in a kiln heated to 450 degrees or just below the melting point of the glaze. The encrusting salts were reduced and brushed off. A less dramatic but no less exacting piece of work was the reconstruction of an Ethiopian alabaster vase from the Soudan, discovered by Prof. Reisner. The silver top was badly crushed and corroded. The salts were reduced in an electrolytic bath, the fine detail was restored and the whole was reshaped.

A donkey draws water. A leaf from an old Persian book of inventions written by an inventor



The Ethiopian alabaster vase found in the Soudan was badly d aged. The encrustation of the silver top was removed electrolytically

A SOLAR OBSERVATORY FOR THE AMATEUR

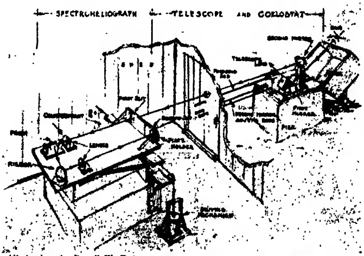
Simple Instructions for Photographing the Sun and Its Eruptions

By GEORGE E. HALE
Honorary Director, Mount Wilson Observatory

BROADCASTS of solar eruptions, like the more familiar radio programs, are sent out on radiations of certain wavelengths. These wavelengths are fixed by the nature of the luminous gases shot from the sun into space. Many leading astronomers, basing their opinions both on observation and theory, believe that such eruptions sometimes shower the earth's atmosphere with electrified particles which set aglow the streamers of the aurora, produce intense magnetic storms, interfere with some forms of telegraphic communication and probably affect radio transmission. But the whole problem bristles with unanswered questions and thus offers splendid opportunities for research, in which amateurs with the simplest equipment may take an important part.

In several papers I have given observations and illustrations of such solar eruptions and explained how a spectrohelioscope for detecting them visually can be constructed at moderate cost. Since describing one form of spectrohelioscope in the SCIENTIFIC AMERICAN[1] I have published a detailed description of an improved spectrohelioscope, already built for use in more than 25 observatories distributed around the earth.[2] All parts of this instrument except the grating can be made by amateurs, several of whom have undertaken the work. For those who want a still simpler and less expensive photographic outfit, which can be built without the aid of machine tools, the following account of a small horizontal telescope and spectroheliograph may be of interest. In spite of the low cost, these instruments can be used for work of great importance in its bearing on the nature of solar eruptions and their possible influence on the earth.[3]

The wavelengths used in radio communication are, of course, far too long to affect the eye. The red line of hydrogen, of much shorter wavelength, is brilliantly visible in solar eruptions. This is the wavelength chiefly used with the spectrohelioscope, where we "tune in" by rotating the grating until this hydrogen line (*Ha*) falls on the second slit and forms the monochromatic image we observe. At the extreme violet end of the visible solar spectrum, where the wavelength is so short that it affects the eye too feebly for visual observations, are the calcium lines known as *H* and *K*.[4] These lines are easily photographed, and our spectroheliograph must be so designed that one of them (*K* is the stronger) can be isolated by a narrow slit. Our purpose is therefore to make photographs of the sun with calcium *light*, which is more intense than any other radiation in the flocculi scattered over its surface and of exceptional brightness in the eruptions mentioned above. For this reason the spectroheliograph is our only means of recording these invisible calcium clouds in the solar atmosphere.



All drawings by Russell W. Porter

Figure 1: **A general view of the apparatus, which constitutes a complete little solar observatory available to the average amateur**

We must have a fixed image of the sun, given by some such coelostat telescope as that described in the papers already referred to, or by the still simpler and smaller instrument shown in Figure 2. I am indebted to Mr. Russell W. Porter for the drawings in this paper and for his help in designing these instruments. They were built by my assistant, Mr. L. R. Hitchcock, to whom credit is due for many elements in their design.

BRIEFLY stated, the coelostat telescope consists of three parts. The first of these is a piece of plane plate glass (C), about three inches square, selected by the method described by Mr. Porter on page 52 of "Amateur Telescope Making" (second edition), and mounted with its face parallel to the earth's axis. In most large coelostats this mirror (silvered on its front surface) is circular, but it is shown square in the sketch to save the necessity of cutting out a circular disk. Any glass cutter can provide such a plate, but several pieces of glass must be tested in the manner described by Mr. Porter in order to find mirror blanks with a sufficiently flat surface.

To reflect a beam of sunlight constantly upon the second mirror, the coelostat mirror must be mounted on a polar axis and rotated by a small clock-movement. The polar axis, as Figure 2 shows, is a very simple affair, consisting merely of a straight steel rod (A) about 3/16 inch in diameter, attached to a square plate of brass or hard wood (B) that serves as a support for the mirror (C). A piece of sheet metal, bent in the shape shown in the drawing, is bored through its upper face to fit the polar axis, which rests against its lower face at (D). The upper end of the polar axis passes through another piece of sheet metal and carries at its extremity a pinion which engages with another pinion attached to the hour-shaft of a small brass clock movement. If the pinion on the

[1]"Solar Research for Amateurs", I and II, *Scientific American*, *140*, 302; and *140*, 436. See also "Amateur Telescope Making", 2nd ed., Scientific American Publishing Company, 1928. [The latter contains a full reprint of the former.—*Ed.*]

[2]"The Spectrohelioscope and Its Work", I and II, *Astrophysical Journal*, *70*, 265, 1929; *71*, 73, 1930.

[3]For accounts of these eruptions and the accompanying auroras and terrestrial magnetic storms see "Signals from the Sun", in *Scribner's Magazine* for July, 1931; and Part III in the series of my articles on the spectrohelioscope, in the *Astrophysical Journal* for June, 1931.

[4]These are the two strongest lines in Figure 7, near the center.

polar axis has four times as many teeth as that on the hour-shaft of the clock, the polar axis will revolve once in 48 hours and the beam of sunlight from the coelostat mirror will be reflected in a fixed direction.

As the drawing shows, the polar axis is inclined at an angle (L) equal to the latitude of the place where it is to be used. Its two sheet brass bearings are mounted on suitable blocks of metal or wood, which are attached to a rectangular base arranged to slide north or south on the underlying support, a straight strip of wood serving as a guide. By fitting the pinion to a sleeve on the polar axis tight enough to drive by friction, but not too tight to permit the axis to be turned within the sleeve, the mirror can be rotated to the proper angle to reflect the beam to the center of the second mirror, where it will be maintained by the clock.

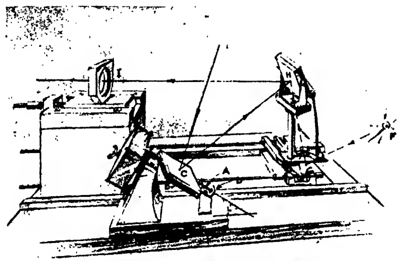


Figure 2: **The coelostat telescope in Figure 1**

THE position of the coelostat, which may be used east or west (before or after noon) of the second mirror (H) and lens (I), depends upon the altitude of the sun, and hence upon the latitude of the site and the time of year. In the drawing, the sun (E) is shown high in the heavens, as in summer; in winter the sun is low, as indicated at F, and the first mirror must be moved south to some point near G in order to reflect the beam to the second mirror.

The second mirror, three inches square, also carefully selected for flatness and silvered on its front surface,[5] must have two motions, both controlled from a distance. (See Figure 1.) It can be tipped about its horizontal axis by an arm projecting down behind and ending in a fork which sits astride a curved cam. By rotating the cam-support the mirror is inclined slightly, thus causing the sun's image to move up or down the slit of the spectroheliograph. Rotation of the vertical mirror-support by means of a second rod gives a slow east or west motion of the solar image. Thus any part of the sun can be centered on the slit.

As the coelostat and second mirrors are nearly plane surfaces, they serve only to reflect a parallel beam of sunlight constantly in a horizontal line to the north. The telescope proper consists merely of a single plano-convex lens (I) about one or two inches in diameter, of from 9 to 18 feet focal length, depending upon the size of the solar image desired. A lens of 18 feet focal length will give a solar image about two inches in diameter, the size of the original photograph from which Figure 8 is reproduced. This is too large to be photographed as a whole by this spectroheliograph, but as most of the calcium flocculi are confined within two zones covering a moderate range in solar latitude, and as the more important eruptive phenomena (for our purpose) usually occur not far from the center of the sun, a two-inch image can be used if it is desired to show the smaller flocculi on a larger scale than a shorter focal length would give. However, a one-inch image, given by a lens of nine feet focal length, may be used if preferred.

Perhaps it should be added that a single lens, even of this small aperture, cannot be expected to show very sharp details in white light, though sun-spots may be seen with it. If of fairly good figure it serves perfectly, however, for the photography of objects like the flocculi with light of a single wavelength, because there is no overlapping of the countless images formed at increasing distances from the lens by light ranging from violet to red.

It is evident that when the calcium flocculi are to be photographed the violet image corresponding to the *K* line of calcium must be focused on the first slit of the spectroheliograph by the method described below. For this purpose a focusing screw, with rod reaching to a point near the spectroheliograph, is provided. As for the telescope lens itself, it may be mounted in a wooden[6] support (with the convex surface toward the second mirror), attached to a sliding block, as shown in Figure 2.

THE coelostat telescope should stand in the open air on a pier about three feet high, as illustrated in Figure 1. To protect it from the weather a waterproof wooden box, arranged to lift off or to turn out of the way on hinges, may be used. A heavy box rammed full of earth will serve very well for a pier, though a concrete pier, on a wider concrete base "floated" on sand to absorb vibrations, is preferable. The spectroheliograph, which must now be described, stands in a small shed to the north, at a distance fixed by the focal length of the telescope lens.

Figure 3, which shows the optical parts of the spectroheliograph, should serve to make its operation clear. The image of the sun, entering the shed through an opening, falls on the slit S_1, seen here (and in Figure 4) from the inside, and in Figure 5

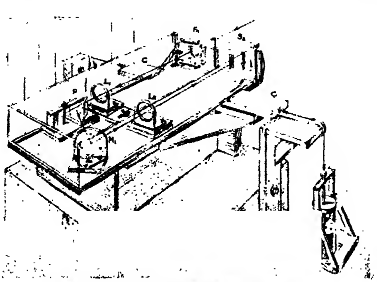


Figure 3: **The spectroheliograph in Figure 1**

[5]Complete silvering instructions will be found in "Amateur Telescope Making," page 130.

[6]All parts made of wood may be prevented from warping by soaking the wood in hot melted paraffin until it [illegible] rated.

Figure 4: **First and second slits, from north**

from the outside. The diverging beam of white light then meets the plano-convex spectacle lens L_1, about 1½ inches in diameter and of 15 inches focal length, mounted with its convex face toward the prism P. As the lens is supposed to be set at a distance from the slit equal to its focal length (for the violet light of the *K* line), a parallel beam emerges from it, and is dispersed by the prism. The short diffuse spectrum thus formed falls upon the mirror M_1, a square or circular piece of selected plate glass, silvered on its front surface. This sends the dispersed light to the lens L_2, which is exactly similar to L_1, and is mounted on the same support, so that both can be moved together toward or from the slits for focusing. A distinct image of the spectrum is thus formed on the brass plate, hinged at one end, that carries the second slit S_2. When this plate bearing the second slit is swung out of the way, the spectrum falls upon a photographic plate held in a plate-holder mounted at a fixed position beyond it. In this way, with the whole apparatus at rest, photographs of the solar spectrum can be taken.

BEFORE describing the adjustments in detail, let us see how the instrument is used. All of the parts enumerated above, excepting the support for the fixed photographic plate-holder, are fastened to a flat plate, which may be of three-ply wood, stiffened by the wooden sides and ends (shown here as transparent for clearness) of the enclosing box that excludes extraneous light, but more advantageously of metal. Under this box, near the slit end, is the cross-plate CC, carrying below it two wooden Vs, lined with sheet steel. The metal faces of the Vs rest on one inch steel balls, shown in Figure 6, which runs in similar Vs on this fixed base-plate, fastened to the supporting pier. Near the other end of the base-plate are two more steel balls, in this case running, not in Vs, but on horizontal plates of sheet steel. Stops at the ends and two parallel guides prevent the balls from dropping out, but do not constrain them in position. Above them is a flat strip of sheet steel screwed to the underside of the box that carries the optical parts. Thus this box can be moved on the balls smoothly across the solar image by any driving mechanism giving uniform motion. A very simple hydraulic device for this purpose is described below.

Let us now imagine the image of the sun focused on the slit S_1 and the slit S_2 set exactly on the calcium line *K*, after this region of the spectrum has been focused on its jaws.[7] The plate-holder is put in position, the slide drawn, and the driving mechanism started. As the slit S_1 passes over the sun's image it crosses the various invisible calcium flocculi, in each of which the dark calcium line *K* is traversed by a bright line determined in length by the width of the area of luminous vapor.

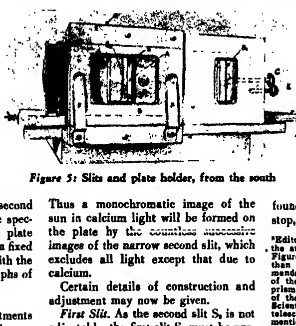


Figure 5: **Slits and plate holder, from the south**

Thus a monochromatic image of the sun in calcium light will be formed on the plate by the countless successive images of the narrow second slit, which excludes all light except that due to calcium.

Certain details of construction and adjustment may now be given.

First Slit. As the second slit S_2 is not adjustable, the first slit S_1 must be provided with several adjustments. The jaws are straight, about 1¼ inches long, bevelled at an angle of 45 degrees on their inner faces (toward the prism), one jaw fixed, the other movable with a fine screw (C, Figures 4 and 5). In practice, the width of the slit is about 0.003 inch. The brass plate (D, Figure 4) that carries the whole slit is movable horizontally by a second screw (E) working against a spring. This is for setting the *K* line on the second slit, so that a range of motion of one eighth inch will suffice. To make the *K* line exactly parallel to the second slit, this brass plate rests on the ends of two screws (shown in Figure 4) against which it is held by a spring pressing on its upper side. When the lid of the prism box is removed a slight adjustment of one of these screws will suffice to secure parallelism, as explained below.

[7]Dust on either slit causes horizontal lines on the photograph. The slits should be cleaned frequently with a thin wedge of soft wood, which may be cut from a match.

PRISMS *and Mirrors.* The flint glass prism is of 60 degree angle, 1½ inches high, with faces one inch wide. It can be purchased from the Gaertner Scientific Corporation, 1201 Wrightwood Avenue, Chicago, where lenses (and mirrors if desired) of a better quality than those generally supplied by oculists can also be obtained.[8] Its simple mounting is shown in Figure 3. After loosening the bar that clamps it in place, the prism is rotated back and forth until the violet end of the spectrum falls at the position of minimum deviation on the photographic plate. This adjustment is easily made by forming an image of the sun on the first slit S_1, (opened widely so as to give a brilliant spectrum), removing the cover of the prism box, and placing a piece of white card in the plane of the photographic plate. Assuming the plane mirror M_1 to be in the right position to intercept the dispersed beam from the prism, and set at such an angle as to reflect it through the camera lens L_2, the image of the spectrum on the card is watched while the prism is rotated. The spectrum will be found to move toward the slit S_1, then to stop, and then to move in the opposite

[8]Editor's Note: In a private communication the author states that "the telescope lens (I, Figure 2) should be of somewhat better quality than ordinary spectacle lenses, but the demands on the short focus lenses and the mirror of the spectroheliograph are not severe. The prism should be fairly good." The manuscript of the article was submitted to the Gaertner Scientific Corporation, which stated that a telescope lens for the coelostat, of the quality mentioned, may be had in 1½ inch diameter at approximately $2.50; the spectacle lenses for L_1 and L_2, 1½ inches in diameter and 15 inches focal length, will cost 60 cents each; while the 60-degree flint glass prism 1½ inches high, with faces one inch wide, will cost about 16 dollars. One inch balls, priced at a retail hardware store in New York, were quoted at 15 cents each.

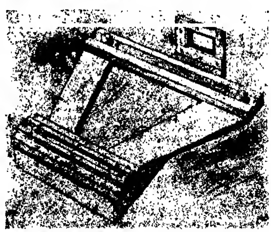


Figure 6: **Base plate to carry spectroheliograph**

direction, as the prism continues to turn in the same direction. The point where the violet end of the spectrum stops before reversing its motion is the position of minimum deviation. The mirror M_1 should be set so as to receive all of the violet light and to send the extreme violet to the second slit when the prism is thus adjusted. The final visual adjustment should be made by watching the spectrum through a magnifier, after narrowing the first slit. As K is not easily seen by most eyes, a region in the violet nearer the blue will serve for this adjustment and the next, which is to move the two lenses until this part of the spectrum is in sharp focus on the second slit. The next step is to incline the first slit toward right or left until the lines of the spectrum are nearly parallel with the second slit. As the lines are curved, the second slit must be curved to match them.

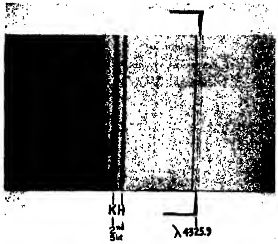


Figure 7: **The violet end of the solar spectrum, showing ultra-violet region to the left, strong *H* and *K* lines (center) at the limit of the visible region, and iron line at wavelength 4325.9 angstrom units on which the pointers are set when the calcium line *K* is on the second slit. Enlarged nearly three diameters from original negative**

ADJUSTMENTS at Second Slit. At this point we may turn to photography. The hinged plate carrying the second slit having been swung out of the way, a few exposures are made to learn the time needed to give the right density at the H and K lines, where ordinary plates are less sensitive than in the blue. Then a second series of exposures, between which the lenses are moved about one eighth of an inch each time, will quickly bring these strong lines into sharp focus on the plate. With the aid of a pair of dividers the radius of curvature of the K line can be determined and the jaws of the second slit S_2 formed to fit the line. It should be added that these jaws are bevelled on the *outside* (toward the photographic plate), so as to present a plane blackened face to the incoming spectrum and thus prevent reflections.*

As the K line is practically invisible, the problem of setting it on the second slit remains. The two jaws of the second slit are fixed in position, at a distance apart of about 0.003 inch. To the right, (toward the first slit, Figure 5) is a small rectangular window (A) in the brass plate that carries the second slit, through which the violet region of the spectrum can be seen. The line selected for setting is the iron line λ 4325.9, (Figure 7), in my instrument about nine sixteenths of an inch to the right of K. This distance is accurately measured on a photograph of the solar spectrum, where λ 4325.9 and K are practically at the same focus. A pair of small wire pointers (B, B, Figure 5), (pieces of wire bent to a right angle), attached to the upper and lower ends of the right-hand slit-jaw and projecting to the right just far enough to place their vertical tips at the correct distance from K, are observed through a magnifier. The first slit is moved as a whole by the screw (E) and the spectrum moves with it. When the two pointers coincide with the line λ 4325.9 the K line must be on the second slit, assuming the measurements and adjustments to be correct. A small brass plate (D, Figure 5), moving easily and made to slip under a groove at the base of the right slit-jaw, is then slid over the window to exclude from the plate all light except that of the K line, which now passes through the second slit.

Focus of Solar Image. The solar image must now be focused on the first slit for calcium (K) light. Look at the image on a white card held against the slit-jaws through a piece of red or yellow glass, and focus the lens of the coelostat telescope until it appears sharply defined. Then move the sun's image until its lower edge is at the middle of the first slit, which should be radial to the disk. Look at the upper edge of the spectrum with a magnifier, and focus the coelostat lens (by moving it north) until this edge appears sharp in the violet. Proceed from this point photographically, moving the lens north about one fourth of an inch between exposures, until an image of the spectrum is obtained which is sharp on this edge at the position of the K line.

Plate-holder. In order to keep the plate as close as possible to the jaws of the second slit, a thin plate-holder is needed. A very good one for this purpose is of light sheet metal and takes a plate about 2¾ by 4¼ inches. This is mounted in a wooden support (G, Figure 5) which holds it in contact with a piece of felt cemented to the brass plate that carried the second slit, but cut away opposite the slit-jaws over an area large enough to transmit the images of the spectrum and the sun. The pressure of the springs (F, F, Figure 5) that hold the plate-holder against the felt must not be great enough to interfere with the smooth and uniform motion of the driving-mechanism.

DRIVING Mechanism. It is not as easy as one might suppose to produce perfectly uniform motion. The spectroheliograph, because of the narrow slit before the photographic plate, has an uncanny way of showing any irregularities, which appear as lines or bands across the monochromatic image of the sun. After using many driving devices at the Kenwood, Yerkes, and Mount Wilson Observatories, I recommend for the present instrument an extremely simple hydraulic arrangement similar to that employed in my earliest work with the spectroheliograph 40 years ago. It consists of a vertical cylinder (Figure 3), in its simplest form merely a circular brass tube about 3½ inches in diameter and 4½ inches high. In this a piston of lead slides easily. A piston rod, passing loosely through a hole in a bar above it, carries the lead driving weights and serves as a guide and as a means of communicating motion to the spectroheliograph by the aid of a thin steel tape or wire. The cylinder is nearly filled with liquid, which may be a thin oil or a half-and-half mixture of glycerine and water, which will not freeze. A counterweight, hanging from a pulley on the opposite side of the spectroheliograph, keeps the tape taut. The speed is regulated by three holes

(*Please turn to page* 283)

*A straight first slit and curved second slit necessarily mean a distorted solar image. A circular image can be obtained by giving each slit half the curvature (twice the radius) found as above for the second slit.

Figure 8: **Photograph of sun, showing calcium flocculi and bipolar sun-spot (near right edge)**

COTTON STALKS, A NEW SOURCE OF RAYON

By PETER A. CARMICHAEL

THERE was a time when the southern cotton planter was of the wealthiest class of American citizens. To-day he has to struggle to make ends meet, and it is by no means uncommon for him to wind up his year with a loss. So adverse were the conditions he had to face the past season that in some cases, as the winter traveler to Florida may have observed, he did not even trouble to gather his crop.

The great development and popularization of rayon has been largely responsible for these changes. But where rayon has been the rival of cotton in the past, it now promises to be the rescuer of it.

In a series of experiments directed by the University of North Carolina the past year, and still in progress, it has been found that the entire cotton plant is capable of utilization in the manufacture of rayon. Lint cotton is a highly desirable source of cellulose, the basic material from which rayon is produced, but because of its cost, the use of it in the rayon industry at present is comparatively slight. The North Carolina experiments, however, give promise of an output of cellulose costing only about one twentieth of what it now costs to supply that material from the lint. The successful application of the method followed in these experiments, which are now well advanced and which have yielded results believed to be of great importance, would revolutionize the cotton-growing industry.

THE great majority of rayon manufactured in the United States comes from wood pulp. The process, briefly described, is to extract the pulp, or cellulose, by means of a chemical treatment which dissolves out the lignin, fats, resins, and other materials; then to treat the cellulose with other chemical agents—the principal one of these now used is sodium hydroxide—and finally to force the resulting viscous substance through exceedingly fine perforations somewhat like those of a sprinkler. Tiny threads emerge, are dried, and then are so nearly like silk in appearance that it is almost impossible to distinguish some varieties of them from silk. These are woven into rayon fabrics.

It happens that the wood best suited for rayon making is spruce, and the supply of that, while ample for present needs, is by no means so abundant as to leave the rayon industry without thought of future sources. To grow a spruce tree to the size at which it can best be utilized for rayon manufacture requires many years. It is evident that with the industry expanding at its present rate—and just now there are prospects of great new advances for rayon, which promise an altogether new textile resembling wool—something may soon have to be found to supplement spruce. With cotton cellulose available at one twentieth of its present cost, it would appear that the problem of a source of raw material had been permanently settled.

Mr. Dockery, whose cotton stalks are being made into rayon in the experiments

In the chemistry department of the University of North Carolina, near the cotton-producing lands and the rayon-manufacturing centers, the work is now in progress which promises to supply a material that will not only supplement wood pulp but may take its place altogether. The experiments, directed by Professor Frank K. Cameron, are being carried out simultaneously in the university's laboratories and on a cotton plantation of several thousand acres near Rockingham, North Carolina. This plantation is owned by one of Professor Cameron's students, Nicholas W. Dockery, and the latter's mother. Young Mr. Dockery is in charge of the experiments on the farm and, to facilitate the work, he has established a well equipped auxiliary laboratory there.

BY present methods, cotton is produced only with considerable care and expense. It must be planted in rows some four feet apart. It requires much cultivation, in the form of thinning and plowing, during the growing season. When harvest time comes it is picked, almost entirely by hand—a very tedious process—and then ginned. The stalks are left standing in the field, being thought worthless except for refertilizing the soil out of which they grew.

This is changed from first to last in the North Carolina project. In that project the whole plant—stalk, lint, seed, and all, except the roots—is utilized. It is mowed like hay and then baled without either picking or ginning. The mass in its entirety is then available for conversion into its constituent substances, of which the main one is cellulose, and thereafter the cellulose is ready to be turned into rayon.

The stalk is no problem in the production of cellulose, being itself high in content of that material, but the seeds have raised considerable difficulty for the experimenters, just as they did for cotton growers and manufacturers before Eli Whitney invented the cotton gin. The cotton seed is very valuable for the fats and oils which it contains, as it is one of the chief sources of material for making soap, glycerine, and cooking oils. Besides these, it yields a variety of other products, ranging from fertilizer and cattle feed to a substitute for olive oil. To-day the seed is worth about one fifth as much as the lint, yet there was a time when it was thrown away or destroyed—before scientific re-

search had found ways of reclaiming the oily center which it contains.

It is because of their value that the seeds are a problem. Their content must either be recovered from the pulping process or else preserved by some other means, in order that the utmost may be realized from the present undertaking.

It is possible, though exactly how practicable is yet to be determined, to put the whole plant, including seeds, through the pulping process and then recover the seed oil. The latter is then available for soap making. By further chemical treatment and refinement the experimenters hope to restore it for all of its present uses.

ON the other hand, the seed can be saved by ginning, without, however, the necessity of continuing the slow and expensive operation of picking the cotton. In this case the entire harvested plant is put through a gin. Considerable trash from the stalk may be mixed with the lint when the latter comes out, but that is of no consequence, since the whole mass, exclusive of the seeds, is then turned into the pulp mill. This has been found practicable, in these experiments, with the use of an ordinary gin.

Lint cotton is probably the richest of all sources of cellulose. It is in fact almost entirely cellulose, showing, on the Carolina plantation, a content of about 95 percent of that substance. In tests performed there and at the university on samples gathered by the hundred each week during the 1930 growing season, a content of approximately 60 percent for the whole plant, lint included, was found. The yield from spruce is approximately 52 percent.

All the tests so far made in these investigations have been made on cotton plants grown in the manner now almost universally followed. That is, these plants were grown in rows of the usual width and with the customary amount of cultivation. However, the experimenters propose an entirely new way of producing the crop, and this is one of the features of their project.

Instead of planting in rows as at present, they are going to sow or broadcast the seed, like small grain. Now, plants that are crowded mature faster than others, as do animals and human beings as well. This means that the cotton stalks should produce more lint, relative to the size of the plant, than they do now, and as a consequence the experimenters believe the cellulose yield from the whole plant will be increased to about 65 percent. There already exists some experimental evidence in support of these expectations.

Under the present methods of cultivation young Mr. Dockery's lands averaged some 2300 pounds of cotton and stalk per acre the past season. Under the broadcast-planting method it is conservatively estimated that the yield will be 5000 pounds. If the present yield of lint alone were turned into cellulose, the output of the latter would be about 330 pounds per acre. But if the stalks and all were thus converted, the cellulose yield, counting 5000 pounds of crop to the acre, would be some 3250 pounds—or 10 times as much.

Another way of planting is also to be tried next season. The seeds will be drilled into the soil in rows very close together, like wheat.

Under either broadcasting or this kind of planting, it will be unnecessary to do any cultivating whatever. But without cultivating, the soil is likely to produce a big crop of weeds amidst the cotton, and so reduce the output of the latter. The experimenters are ready to meet this obstacle, however, by planting broom sedge or some similar grass along with the cotton to rout out the weeds. Broom sedge, being a hardy, fast-spreading plant, dwarfs weeds; moreover, it is high in cellulose content, and will be harvested along with the cotton and turned into cellulose also.

Test tubes showing steps in the conversion of entire cotton plants into rayon

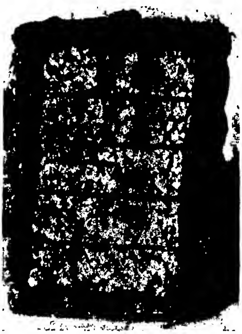
IN addition to the immensely increased yield expected from either of these ways of planting, there is a prospect of a great saving in the method of harvesting. Instead of picking the cotton by hand and leaving the stalks standing in the field, it will be possible, as was found last year, to gather the whole plant by mowing it down with power-driven reapers. It will then be compressed into bales and shipped to the pulp mill. All this will be done by a few hands in only a small fraction of the time that it now takes a field full of hands to accomplish the same result.

On the lands where the investigation was made during the past season, it costs an average of approximately 23 dollars an acre to produce the crop by the old method. After making all reasonable allowances, based on considerable experience in cotton growing, Mr. Dockery believes that production in the *new* style will cost only about one half as much. Since a cellulose output nearly 10 times that of lint is promised, and since it is expected to cost only half as much, the net effect should be a cellulose costing just one twentieth, approximately, of the present figure. It is not difficult to judge the advantage this would mean to the rayon industry.

In the experiments, the cotton—bolls, stalks, and all—has been cut by hand. Should the process prove commercially practicable, machines would do the work

After mowing, the cotton plants are hauled away and baled without either picking or ginning. The process of harvesting is thus greatly simplified

Nor is this all. Cotton is regarded as the choicest raw material for the production of rayon, but the cost of it has heretofore restricted its use to the production of the more expensive rayon goods. Should it prove a competitor with wood pulp, as the Carolina venture strongly indicates it can do, then a generally higher quality of rayon could be expected. In addition to this, the investigators are of the opinion that an even higher grade of cotton cellulose can be produced by their methods.



THE development of this enterprise to anything like the degree that appears open to it, would mean nothing less than a revolution in agriculture in most of the cotton-growing states. At the present time cotton culture in the southeast, the region where it had flourished for a hundred years prior to the World War, is in an alarming state and one that promises to grow even worse. Three different conditions threaten to make its successful continuance in the southeast impossible.

One of these is the above-mentioned exploitation of rayon itself. The rapid development of that textile has cut heavily into the use of cotton fabrics, with the result that the demand for raw cotton has greatly declined.

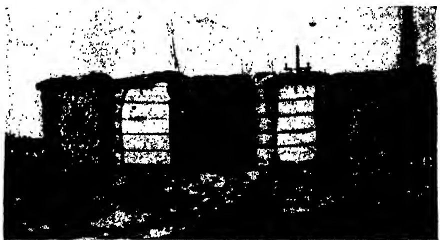
A second such element is the now probable development of a machine for picking cotton. This machine is said to operate best on level lands. It would be especially adaptable to the plains of the southwest, where cotton more desirable because of its longer fiber than that of the southeast is already a leading crop. The saving from it would be immense, and the section that could best employ it would be the section to supply the material for the future manufacture of cotton goods.

Finally, there is the growing threat of the expansion of cotton production abroad. We are still one of the world's chief sources of cotton. Our exports of it exceed those of anything else we send away—including automobiles, oil, wheat, and machinery. But India and Egypt have long been competitors with us, and to-day Russia is making a bid for the same status. It is believed likely that still other parts of the world where very cheap labor can be had will before long turn to the production of cotton. These include portions of Africa outside of Egypt; Spain, where experimental production is reported under way; and possibly South America.

WITH the demand at home dwindling and with the prospect of losing our export markets to rivals abroad, it is evident that the outlook for cotton is anything but bright. But if some new use could be found for it, and if some means were discovered whereby it could be produced at less cost, the whole complexion of the problem would change. And if such a project as the North Carolina chemists have under way should turn out to be the success which the results so far indicate it will be, the problem would vanish.

Exploitation of this project would also mean the replacement of many farm hands by machinery and, in consequence, probably some fundamental change in the tenant system, a bane which has given the southeast no end of tribulation. Tractors and mowing machines would be used where common labor now does the work. Most of the labor that would then be needed would probably move from farm to farm, following the course of the crop's development, as is done in the western wheat fields.

This and the other changes which would be brought about by the new methods would put cotton farming on an entirely new basis. Altogether, these changes would doubtless be the biggest thing in the history of cotton since the invention of the gin, more than a century ago.



Bales of plants as they come from the field compared with bales of lint and, in center, with bale of stalks. *Above:* Close-up of bale of unpicked c

All photographs courtesy Field Museum of Natural History

A partially completed artificial skin is in the foreground. To rear, coating is supported by wire and papier mâché

The plaster mold encloses the model. The heavy wooden framework prevents warpage and aids in handling parts

A completed hippopotamus exhibit, showing the great strength of the model. The colored translucent artificial skin makes possible perfect reproduction

By a special de-hairing treatment, the hair is transferred to celluloid

CELLULOID TAXIDERMY

A MEMBER of the technical staff of the Field Museum of Natural History, Mr. L. L. Walters, has discovered that, in taxidermy, the conditions of natural coloration can be produced by using pigments added to a translucent material. This is generally known as the "celluloid process," although, strictly speaking, celluloid is only one of the materials that have been employed.

The colors are prepared by adding pigment to a cellulose solution; cellulose nitrate, cellulose acetate, or pyroxylin is generally used. The color is thus applied in the mold and not to the finished cast. Each colored mixture is applied or painted in its proper location on the interior surface of the mold. After this work is completed, layers of other materials such as cloth and wirecloth are added for further strength and support. The replica, entirely complete as to coloration, is then removed from the mold.

To extend these methods to mammal work, the variation from the regular procedure requires a method which provides for the correct transference of the hair. It first calls for the construction of an armature or frame and a clay figure in the ordinary way. The skin, in a freshened, soft, plump condition, is adjusted on a form. The molding material entirely surrounds the individual hairs and takes an exact impression of the skin surface between. When the mold is completed and reinforced and the interior clay structure removed, the skin remains attached to the mold by the embedded hair. Through de-hairing treatments, such as are in use in tanning operations, the tissues surrounding the hair roots are acted upon and the skin detached and removed from the mold. The mold then presents an accurate negative of the skin surface with the root of each hair protruding and exposed. The colors are prepared and applied in the usual manner, the liquid cellulose acetate or nitrate surrounding each hair root. On the evaporation of the solvent, the hair is left embedded in the solidified material.

The rock dust from the drills is impounded by the cap and is removed by suction to a receiving tank. The air is then deflected, sprayed with water, filtered, and the sludge returned to the settling tank

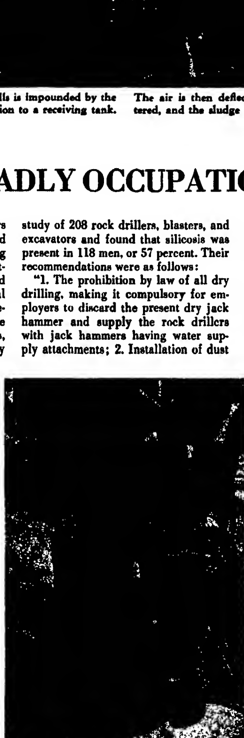
TAMING A DEADLY OCCUPATIONAL DISEASE

SILICOSIS, defined by the doctors as a "fibrosis of the lungs induced by the inhalation of dust containing free silica," is perhaps the most important of all our occupational diseases and one of the most deadly. An occupational disease has been defined as "morbid results of occupational activity traceable to specific causes or labor conditions, and followed by more or less incapacity for work." In a city like New York, which is indeed "founded on a rock," the rock driller and blaster are essential to construction work. These men carry on their noisy operations year in and year out, with the full knowledge that in the end they may be seized by tuberculosis, an aftermath of silicosis. What they probably do not realize is that if they remain in this occupation even a few years, the injuries they sustain may be permanent.

SILICOSIS is not limited to rock drillers, but also occurs in workers who do hard rock metal mining, granite cutting, metal grinding, and sandblasting. Much attention has been given to the subject by eminent doctors and industrial hygienists, and New York has proved to be an ideal place to carry on practical investigations, owing to the type of rock which gives the greatest possible chance for injury. The highly variable micaceous schist is very massive and rich in quartz.

The Silicosis Committee, composed of nine doctors and experts, made a study of 208 rock drillers, blasters, and excavators and found that silicosis was present in 118 men, or 57 percent. Their recommendations were as follows:

"1. The prohibition by law of all dry drilling, making it compulsory for employers to discard the present dry jack hammer and supply the rock drillers with jack hammers having water supply attachments; 2. Installation of dust and sludge collectors, or attachments to drilling machines; 3. Adequate ventilation in tunnel work; 4. Proper spacing of drillers so as to reduce the dust concentration in given areas."



Dust cap at the base of each drill is attached to an air suction system by a hose

It is interesting to note that 27 patents for dust and sludge collectors have already been issued.

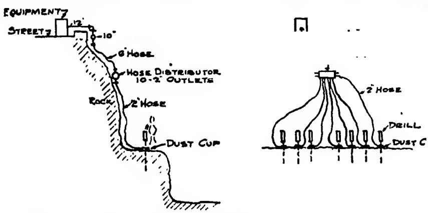
Mr. George S. Kelley, construction engineer for the George J. Atwell Foundation Company, New York City, attacked the problem and has succeeded in making a "man size" demonstration with the co-operation of the State Department of Labor; the Industrial Department of Hygiene, Metropolitan Life Insurance Co.; and the Harvard School of Public Health. The expenses of the installation were borne by the Metropolitan Life Insurance Co. and the tests were conducted through the courtesy of Starrett Brothers and Eken, contractors for the excavation for a new building for the life insurance company. The work involves the removal of 80,000 cubic feet of rock.

AROUND each jack-hammer drill is a casing or hood in the shape of a truncated cone with a flat top. It is made in two parts, which are kept closed by a spring. A piece of two-inch pipe is fitted to the cone and adapted to receive the clamp of a suction hose. The drill steel rotates freely in a one and one-quarter inch hole in the top.

Mr. Kelley employs a high suction

to form an air seal so that not only is the air which issues from the hole withdrawn, but in addition a very strong current of air is drawn through the space between the hood and the drill. With this strong suction it was found that the cuttings can be removed from the hole so rapidly that the cutting speed of the drill is increased and the particles are of large size because they do not drop back into the hole to be ground under the face of the bit. In addition there is no dust lying on the ground surface to be stirred up by the operator's feet or subsequent blasting operations. The exhausted air discharges into a dust collecting system which removes the fine material so as to present no health hazard at the street level.

Our diagram shows the way the drills are hooked up. The lot which is being excavated is completely surrounded by



Section showing edge of excavated area and the location of dust control equipment, hose distributor with outlets, and hose running to dust caps and drills

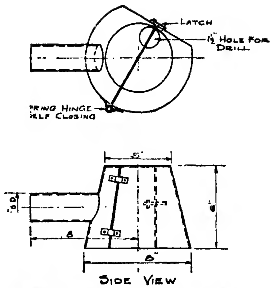
a 10-inch pipe. At every 40 feet in this line is a 6-inch outlet which leads to a distributor, or manifold which has ten 2-inch outlets, to which ten hoses for the individual drill hoods are attached. The air suction is provided by a General Electric centrifugal compressor with a capacity of 3500 cubic feet per minute at one and one-quarter pounds pressure.

The plan view shows the mechanism of the dust collector. The dust-laden air drawn into the receiving tank where the heavier particles fall by gravity. The air, still laden with its freight of fine rock dust, passes through air chambers having deflectors and water sprays. Part of the dust falls into a sludge tank immediately in front of the work-

top of the opposite page. The air, now laden with only the finest dust pa

through filters in the squ column at the right and i. passed out into the open air, purged of all its dust. The sludge passes from the sludge tank and the filtering tank to the open sludge tank at the left for ultimate disposal.

Using a standard of safe dust concentration determined from previous studies of the health hazard associated with rock dust it was found that a minimum flow of 60 cubic feet per minute was necessary to control the dust hazard associated with rock drilling. Operating at this air flow the efficiency of the collection of cuttings from the drill was very high and with 25 drills operating, as much as two tons of ground material have been collected in eight hours. This by-product is worth 40 dollars a ton as an abrasive.



Dust cap showing method of attaching the air suction hose. It requires no adjustment

It was demonstrated that dry drilling with this system is superior to wet drilling for the prevention of silicosis. This method s so allows for the use of the full available pressure.

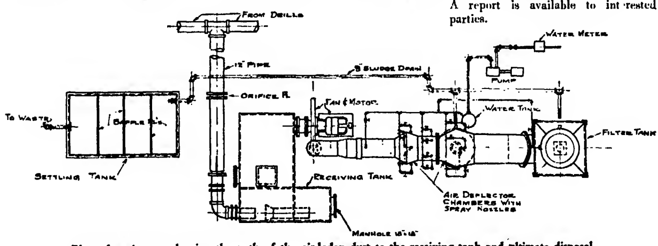
As soon as the Department of Labor is satisfied that the results are entirely satisfactory and after checking by the scientists who have been watching the experiments, it is well within the limits of probability that this method of drilling will cause a new code to be ordered nilar

all rock-drilling operations. If, as is often the case, the new plan saves the contractor money, so much the better.

The Altman Foundation has furnished the necessary funds to conduct the elaborate studies carried on by the Silicosis Committee. The study was instigated and the physical examination of the workers carried out by the Industrial Department of the Institute of Public Health of Columbia University. The medical report was prepared by Dr. Adelaide Ross Smith of the above named department. The New York Tuberculosis and Health Ass

the co-ordinating and financial

A report is available to int·rested parties.



Plan of equipment showing the path of the air-laden dust to the receiving tank and ultimate disposal

COMBATING MAGNETISM IN WATCHES

By GEORGE P. LUCKEY

Magnetism in an ordinary watch attracts hairspring to balance arm

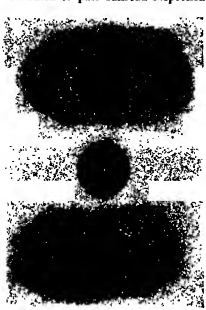
CONSIDERING the delicacy of their works and the continuity of their operation, year in and year out, watches are given perhaps the least attention of any mechanism in wide use today. The owner of any reasonably good watch will carry it in the warmth of his person during the day, through all his varied duties and exercises, no matter how arduous, will wind it at irregular intervals, lay it upon a cold dressing table, and expect it still to keep fairly good, if not perfect, time. Fortunately it can do this, for watchmakers have combined in moder watches ruggedness and good time-keeping qualities; and for many years have so constructed the balance wheel and hairspring—the watch's heart which oscillates at the almost unbelievable rate of 157,680,000 times annually—that they withstand normal changes of temperature. The question of magnetism, however, has been more baffling.

There is no surer way of obtaining poor time-keeping quality from a watch than to place it for a fraction of a second in a magnetic field strong enough to magnetize its steel parts permanently.

ONCE a watch has been magnetized, its usefulness as a time-keeper is destroyed until it is demagnetized. Such demagnetization can be accomplished by placing the watch in an air-core solenoid excited by alternating current and then drawing the watch rapidly away from the solenoid. However, in order to demagnetize the watch completely, it is usually necessary to disassemble the entire watch movement and demagnetize each part separately. Because of the extremely harmful effect of magnetic fields, anyone owning a high-grade watch has always been warned against carrying it near electrical apparatus where it may be influenced by strong magnetic fields.

A watch consists of essentially four elements: (1) the driving power or the mainspring; (2) the train of gears that transmit the power from the mainspring; (3) the escapement; and (4) the balance wheel and hairspring. The most essential part of a watch is the balance wheel and hairspring, a periodic system which, in the standard watch of today, oscillates with a frequency of 18,000 vibrations per hour. The time-keeping qualities in a watch are determined by the constancy of the vibrations of the balance wheel and hairspring, and the rate at which the power is released to the balance wheel and hairspring is governed by their period of oscillation. Anything which disturbs this period of oscillation directly affects the time-keeping qualities of the watch.

A watch to pass railroad inspection



Magnetism of steel hairsprings and lack of magnetism of Elinvar springs—subjected to same magnetic field

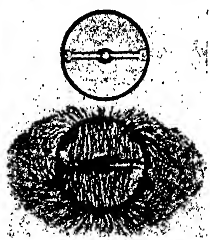
must keep time within 30 seconds a week. In a week there are 604,800 seconds and thus a watch to keep time within 30 seconds a week is operating with an accuracy of .005 percent or better. From this it can be seen that relatively slight disturbances affecting the period of the balance wheel and hairspring may cause a considerable effect in the time-keeping accuracy of a watch.

A watch movement of necessity contains a large number of steel parts used both as springs and as bearing and wearing surfaces. Such parts, in the conventional watch, are the mainspring, winding and setting mechanism, stem work, pinions, parts of the escapement and balance, and the hairspring. Steel was heretofore necessary in these parts both because of its elasticity and because no other material could be prac-

There is no harmful magnetic effect between Elinvar watch parts

tically used to furnish the long wear necessary.

The hairspring of the watch has been made of steel because of the elastic qualities which are required. The steel used has the defect common to practically all metals: its elasticity is influenced by temperature, becoming stronger when cold and weaker when warm. This defect, which would make a watch run fast when cold and slow when warm, is compensated for by making a balance wheel in which the arm of the balar and the inside of the balanc made of steel and the outside im of brass. The rim of the bal- cut on opposite sides near the that this rim acts as a bi-metallic the free end moving in towards when warm and moving out when cold. Then by properly weighti the balance wheel with screws a watch



Steel filings cluster about bi-metallic balance wheel but not about a solid ring mono-metallic wheel

movement is obtained which will keep perfect time independent of normal variations in temperature.

If a watch is magnetized in a strong field, the most striking effect observed is that between the hairspring and the balance arm. In order that the mechanism may be contained in a small space, the hairspring is placed directly above the balance arm. If the balance and hairspring become magnetized to their fullest extent, the balance arm will attract the hairspring with such force

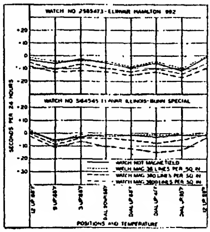
that the hairspring lies directly on the balance arm and stops the movement of the balance.

In case these steel parts are not so highly magnetized, a few coils of the hairspring may touch the balance arm or at certain times or in certain positions a coil of the hairspring may rub on the balance arm. When this occurs, the time-keeping becomes extremely erratic. Even if the hairspring is not magnetizable, there would still remain a strong effect due to magnetism between the balance arm and any magnetized steel parts.

It can be seen, then, that in order to construct a watch movement which would not be strongly affected by magnetism, the first essential would be to obtain a balance wheel and hairspring containing no material that could be permanently magnetized. However, such material must have the same or better physical characteristics than those used in conventional watches. As stated above, the predominating effect of temperature on a watch is due to the change in the elasticity of the steel hairspring. In case the elasticity did not change, the change in size of the hairspring due to an increase in temperature would cause the spring to become slightly stronger so that the watch with such a hairspring would gain about a second a day for a change in temperature of 1 degree Fahrenheit. The expansion of the balance wheel, due to the same increase in temperature, would cause the watch to run slow approximately the same amount. These two effects could, by proper choice of the material of the balance wheel, be made to compensate each other. Thus if it were possible to obtain a hairspring in which the elasticity is not changed with temperature, it would be possible to use a non-magnetic material of the correct coefficient of expansion for the balance wheel and the worst effects mentioned above as due to magnetism would be eliminated.

A HAIRSPRING material which has these qualifications is found in Elinvar, a nickel-chromium-steel alloy developed by Dr. Guillaume, Director of the International Bureau of Weights and Measurements, who is well known because of his invention of Invar. Elinvar has the elastic qualities of the best grade of hairspring steel, and further, its elasticity over the normal range of temperature experienced by watches can, by proper selection, be made practically constant so that when it is used with the proper type of non-magnetic solid balance wheel, the errors due to the effect of temperature are as slight as, or less than, those experienced with high grade watches using a split bi-metallic balance wheel to compensate for temperature effects on a steel hairspring. Elinvar though attracted by a magnet will not become permanently magnetized. Since a non-magnetic balance wheel can be used, the major effects of magnetism can be eliminated.

In addition to minimizing the effect of magnetism, the combination of an Elinvar hairspring with a solid non-magnetic balance wheel has other advantages over the conventional bi-metallic balance and carbon steel hairspring.

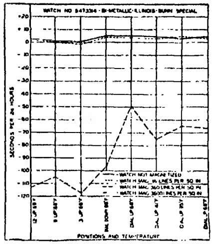


Elinvar will not rust and hence eliminates one of the serious difficulties experienced with steel hairsprings. In order to obtain proper time-keeping quality in a watch held in any position, it is essential that the balance wheel be accurately poised to obviate any influence by gravitation. A bi-metallic balance has a split rim and because of the movement of this rim with changes in temperature, it is difficult to poise this balance wheel properly and keep it poised when affected by jars, vibrations, and changes in temperature. These troubles are eliminated when, because of the Elinvar hairspring, a solid balance wheel can be used.

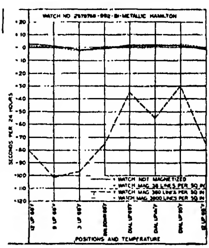
EXPERIMENTS have been carried on for a number of years with Elinvar hairsprings and mono-metallic balances with the view of eliminating, as far as possible, the effects of magnetism and, at the same time, retaining the necessary good qualities of the steel used throughout the watch. These experiments have resulted in the production of a watch movement which is only slightly affected even if all the steel parts in the watch are permanently magnetized to the greatest degree.

The Elinvar watches, after magnetization, have all their steel parts magnetized to the greatest degree and such a watch is sufficiently magnetized so that if it is placed in proximity to a watch with a bi-metallic balance, it will greatly influence the latter's rate.

It must, of course, be considered that the watches used in the experiments mentioned have been tested after magnetization and not while remaining



Self-explanatory graphs showing the reaction of Hamilton and Bunn bi-metallic and Elinvar watches to magnetism at various temperatures



continuously in a strong magnetic field. It is very doubtful whether a watch can be constructed from conventional materials and be made to run and keep time in the strongest magnetic fields. The effect of the eddy currents alone, induced in the balance due to its high speed of rotation, would in all probability cause sufficient retardation to affect the time-keeping of a watch greatly. It should be remembered, however, that no watch is apt to be placed permanently in a magnetic field and that an Elinvar watch when momentarily placed in a magnetic field will not be noticeably affected.

From the results of the tests it has been shown that the Elinvar hairspring and mono-metallic balance equipped watch offers to the electrical engineer or to men working around electrical machinery a new possibility in obtaining accurate time. It is no longer necessary to avoid carrying such a watch into the close proximity of a magnetic field and even though the watch may be slightly influenced while in a strong magnetic field, it will keep as good time afterwards as before, whereas the ordinary watch would be useless.

WHEN A SUNBEAM SPLITS

By Z. MOOR

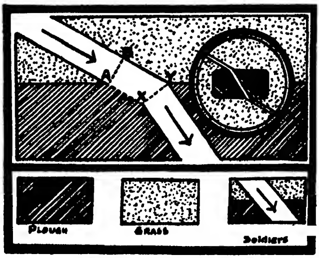
OUR readers may think the accompanying article somewhat juvenile. It is. The *Scientific American* has relatively few juvenile readers, not being aimed at them. Despite these facts we publish this elementary article because we like it ourselves. The author's neat drawings caught our attention and his analogy between a beam of light entering a denser medium and a rank of soldiers entering obliquely on rough ground struck us as fortunate. If you have ever drilled soldiers you will know.—*The Editor.*

MOST people in using a magnifying glass, or in looking through a badly glazed window, will have noticed that the outlines of objects become not only blurred, but colored. They appear to be surrounded by a belt of light, red at one edge and violet at the other. When bright sunlight shines obliquely through a window it often casts similarly colored lights on the wall. This colored belt is, in a very imperfect form, what is called the spectrum.

Actually, sunlight is composed of seven different colors, all blending to form white. The perfect spectrum, secured by directing a beam of light through a series of lenses and prisms, shows seven parallel belts of red, orange, yellow, green, blue, indigo, and violet.

Securing a perfect spectrum is really a simple business, provided the formation of the spectrum is understood. It is due to the fact that the rays bend when passing from one medium into another of different density, as from air into glass. Its action in passing from air into glass may be compared to that of a platoon of soldiers marching obliquely across the borderline between a smooth grass field and a plowed area. The body moves in a straight line until it reaches the plowed ground, but as soon as the first man finds himself on more difficult ground his pace decreases. As a result the outside man gains a little before he too encounters the rough patch. Then his pace decreases in the same way. The result is that the front line has wheeled slightly around the first man to compensate for the fact that the outside man has moved a little farther, as shown in the diagram. As each line crosses into the plowed field, the same thing occurs, so that when half the troop is on the grass and the remainder on the plowed part, the long line of soldiers is bent toward the center of the field. When the troop passes from the plowed field back again to the grass, the line bends again, this time in the opposite direction, as walking becomes easier.

Precisely the same thing happens to a beam of light passing through a block of glass. It strikes the surface of the glass, and bends toward the normal—a line drawn at right angles to the surface of the glass at the point where the light enters. It passes through the glass in a straight line, and then comes out into the air, when it is bent again, this time away from the perpendicular line.



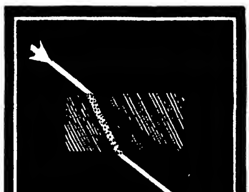
An exact analogy: When light enters a denser medium, like glass, at an angle it is bent or refracted; for the same reason a "column of squads" entering on rough ground at an angle is partly turned—because the velocity is less

In each case, it is bent through exactly the same angle, though of course in opposite directions. If the block of glass has parallel edges, the ray emerging therefore takes the same direction as the ray entering, but it has been pushed, as it were, to one side. The same would happen in the case of the soldiers.

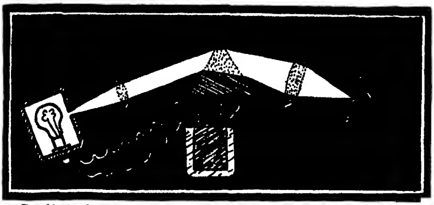
The seven colors making up sunlight all have different wavelengths, red having the longest and violet the shortest. The result is that in passing through glass they are all bent in differing amounts, giving the colors of the rainbow. A crude analogy of this can be made if you think of the colors as seven men, the man on the extreme left being very powerful, and on the right, very weak, the intermediate men being arranged according to strength. If these men walk side by side across our old friend the plowed field, the weakest will find his strength taxed most by the sudden change from smooth grass to broken sod. He will turn toward the normal a little more than the next man, who is slightly stronger, while the strongest man will turn least. The result is that the seven spread out.

This is what happens to the seven colors in sunlight in passing through a plate of glass. If the walls of the glass are parallel, however, the divergence rectifies itself as the light emerges. The obvious thing to do, then, is to use a glass block with sides that are not parallel, a triangular glass known as a prism. By shining a light through such a glass we secure the same effect as we should by marching our soldiers across a triangular plowed field: the line is bent twice, once in going on it and again in leaving it, and both are in the same direc-n.

To secure a perfect spec-



When the beam of light leaves the glass its original direction is restored to it



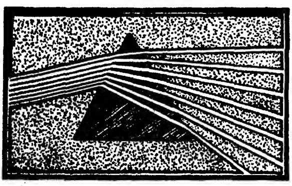
For this simple experiment a common frosted bulb will work. Place lamp within an old cardboard box, cutting narrow (about 1/16 inch) slit opposite filament

trum, a beam of light is directed through a prism. Sun rays are most suitable, as these are always practically parallel, but often it is inconvenient to use daylight, and a parallel beam must be produced artificially. An electric bulb is enclosed in a box (see diagram) with a narrow slit in it and the bright beam of light from the slit is made parallel by using a convex lens placed at a distance from the light equal to its focal length. (At the correct distance the circle of light transmitted through the lens will have about the same diameter as the lens itself.—Ed.)

THE parallel beam now passes through the prism, which splits it up into its seven parts, and if the light is allowed to fall on a white screen the seven colors will be seen, though very blurred and overlapping in places. In order to sharpen the outline, the light passes through the second lens which focuses it on the screen. The result is seven little belts of light, each one, as a matter of fact, a colored reproduction of the original slit of light. This is the true spectrum.

Such an arrangement of lenses with a prism is combined into the more refined instrument known as the spectroscope, which is also fitted with an eye-piece. By looking through this at any light the spectrum can clearly be seen.

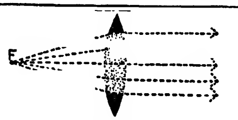
The importance of the instrument lies in the fact that all light is not composed of the same seven colors. If you look through the spectroscope at the flame of a burning piece of sulfur, you will see only one color, a solitary yellow streak. The fact that all burning elements have different spectra, either in the color or positions of the lights, has proved of great value to analysts. When chemical analysis fails, a spectrum of the substance will often reveal its constituents. In some cases the spectroscope reveals such tiny traces of a substance as to be otherwise indiscernible. In others, the instrument is used to study the constituents of a body unattainable for close inspection, for example, in the stars.



How a prism bends the various wavelengths of light: red (at top) the least, violet the most

The constituents of the sun were discovered in this way. Indeed, the presence of helium on the sun was made known long before the gas was ever discovered on earth, for a spectrum of the sun showed a little belt of light which no known substance could produce.

The fact that ordinary light is made up of seven different colors is of considerable importance in photography. In making a camera great care must be taken to insure that the light shall not split up in passing through the lens, giving a blurred image. The simplest reliable lens is the achromatic as used in the cheap box cameras, while finer lenses, the anastigmats, are really a combination of two lenses. Red and orange light, with the longest waves are, photographically, as good as no light at all, while at the other end of the spectrum violet and blue are almost as potent photographically as white light. The result is that red and orange objects, photographed on an ordinary plate, look black on the finished print, as the amateur who has photographed red poppies will testify, while blue or violet objects, such as the sky, come out perfectly white. Color filters which weaken the strong colors more than the weaker ones, thus balancing the spectrum to suit the photographic plate or film, can be used to overcome this difficulty, but the use of orthochromatic and panchromatic plates or films makes this expedient quite unnecessary.



Showing how the rays which diverge from the slit may be made parallel by means of a lens

THIS knowledge of the division of light into seven parts goes far toward solving a problem which has always puzzled scientists, the problem of color. Why is my note book blue and s red? All color is reflected light. The only reason you can see this page at all is that the light from the sun, or some artificial imitation of it, is falling on to it and being reflected. Take away the light, and you can no longer see the page. The suggestion is that an object is blue or red or green because, for some reason, it absorbs all the other colors and reflects only blue or red or green. Thus, strictly speaking, your car is not blue. It reflects particular waves of light, and the sensation thus given to the retina of your eye is called "blue." Why a particular object should absorb six colors and reflect the seventh has yet to be discovered.

●

To ascertain how easily the average amateur might expect to perform at home the little spectrum experiment which the author describes above, the editor tried it without special conditions or materials, except that a prism costing about one dollar was used. A common 40-watt lamp was slid into a square cardboard case removed from a dry cell (the nearest thing handy) and a slit about an inch long and 1/16 inch wide was cut in the box opposite the brightest part of the lamp. The lenses were simply two common reading glasses, a small one and a large one, but almost any lens should suffice. After a few minutes of "juggling" with the distances between the apparatus a neat spectrum was had. If the screen is moved farther to the right than the author indicates the spectral colors should be recombined, giving an image of the original slit in white light. The darker the room the better will be the experiment.

The private car which can be chartered combines the facilities of the private yacht. It includes bedrooms, dining room, kitchen, lounge and baggage compartment. All the cares of the mobile household are assumed by The Pullman Company

THE PRIVATE CAR, YACHT OF THE RAILS

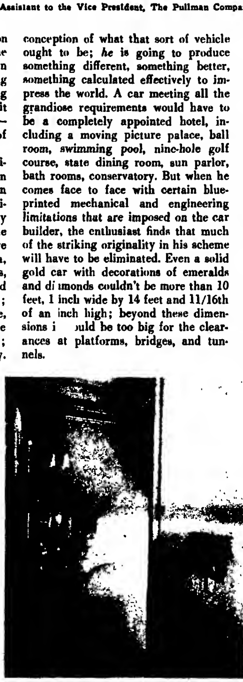
By JUDSON C. WELLIVER
Assistant to the Vice President, The Pullman Company

IT is seen in the railroad yards, on the rear end of the express as she roars through the countryside, on the siding near a millionaire's hunting or fishing camp. Resplendent in shining paint and gleaming metal work it stands as a symbol of luxury on land—the private railroad car, the yacht of the rails.

During the last half century, approximately 350 private cars have been built, according to the best information available. About 225 of these are business cars, while the rest are properly private cars and those owned by The Pullman Company. Of the latter there 23, all fully equipped with china, glass-ware, silver-ware, kitchen utensils, linen, and the rest. A car may be hired for two days or less for 175 dollars; three days to twenty-nine days inclusive, 75 dollars per day; thirty to eighty-nine days inclusive, 65 dollars per day; ninety days or more, 50 dollars per day. The charter fee includes the services of a cook and two attendants. The company also assumes the responsibility of stocking the car with food stuffs, charging the actual cost plus 25 percent. The rental is of course in addition to the regulation 25 railroad tickets for transportation, plus 10 percent surcharge; and the 25 tickets must be forthcoming whether the car carries only one passenger or the full number.

WHEN one leases a car from The Pullman Company, he has the assurance that a highly efficient organization will look after it and all its relations with the railroad while it is *en tour*, thus relieving him of many onerous responsibilities in this regard.

Nearly everybody who goes in for his own private car opens up the subject with the general notion that nobody else ever had an adequate conception of what that sort of vehicle ought to be; *he* is going to produce something different, something better, something calculated effectively to impress the world. A car meeting all the grandiose requirements would have to be a completely appointed hotel, including a moving picture palace, ball room, swimming pool, nine-hole golf course, state dining room, sun parlor, bath rooms, conservatory. But when he comes face to face with certain blue-printed mechanical and engineering limitations that are imposed on the car builder, the enthusiast finds that much of the striking originality in his scheme will have to be eliminated. Even a solid gold car with decorations of emeralds and di monds couldn't be more than 10 feet, 1 inch wide by 14 feet and 11/16th of an inch high; beyond these dimensions i ould be too big for the clearances at platforms, bridges, and tunnels.



Staterooms in private cars are appropriately furnished to give maximum comfort

Within the limitations of height, width, length, weight and strength, the designer of a private car still has considerable latitude for the exercise of his notions about arrangements, comfort, decorations, and so on. An honest-to-goodness fireplace, in which to burn real logs, has been built into a private car, with a fan arrangement which insures an excellent draft.

THE builders of private cars would be positively shocked to receive specifications that did not include a few strictly secret drawers and lockers. These are seemingly as necessary and inevitable
chambers and blind stairways
dieval castle where a mystery murder is to be staged. People who specialize in astonishing electrical contraptions find that a private car affords particular opportunities for the exercise of the ingenuity. Some of them have put curious annunciator and phone systems inside the car; many provide telephone instruments with arrangements to plug in a connection with the local telephone system whenever the train is standing at a railroad station. Practically all recently built private cars have had aerials stretched along the roof, as equipment for radios.

In a general way, the purchaser of a private car has the privilege of dividing up his interior pretty much as he likes. Some cars have a long lounge room at the rear, which is also used as a dining room; others have a dining compartment in the middle of the car so that the rear lounge section will never have to be invaded by the dining arrangements. The amount of space that can be given to these public rooms depends, of course, on the number and size of sleeping rooms that are provided. There are usually three, four, or

five state-rooms; probably the majority of cars have the four-room arrangement. The kitchen, pantry, refrigerator, and the storage spaces are patterned very much after that of a dining car but on a smaller scale as fewer people have to be served. All private cars are built with the passage-way along the side.

In the matter of interior finish and decoration there is a wide range for individual taste. Most of the cars are finished in either mahogany or walnut, the latter being at present favored; in some a finish in imitation of grained wood is applied. A trunk and baggage room is commonly included in the arrangement, and of course there must be a complete bathroom with tub as well as shower. Some private cars have two bathrooms. The railed-in observation platform at the rear may be open, semi-enclosed, or entirely enclosed in glass, its dimensions according to the wishes of the owner.

Next to an invitation for a yachting cruise, the tender of hospitality for a select private car tour is about the *beau jeste suprême* among the social amenities. The skipper of a private car can always be reasonably certain of good company whenever he wants to use it. The private car dinner party is always an attractive form of entertaining. For sight seeing, hunting, and the various modes of "roughing it" in complete ease and comfort, the private car offers unsurpassed privileges. Consequently, in times when people feel comfortable about the stock market and their balance at the bank, there is a pretty active demand for cars.

The family drawing room exists in private cars as well as on limited trains. Here children can have a happy time of it as a private car gives many chances for playing hide and seek

Private cars afford space for boudoirs for our ladies, who can find adequate facilities for bathing and making an elaborate toilet. The car can of course accommodate a ladies' maid

The Pullman Company furnishes a competent chef and t cost plus. Here is the galley

The dining room appointments in the way of napery, silver, porcelains, and crystal equal those of a mansion

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

Anti-Cavitation Marine Propeller

THE Canadian National freighter *Cornwallis* recently sailed from the British West Indies for Quebec and Montreal, completing the first of two voyages during which she is testing a novel propeller with which she was equipped a short time ago in Montreal. Aboard the freighter were two engineers, one connected with the Canadian National Steamships and the other with the Master Propeller Company of Canada, promoters and world controllers of the new propeller. Weather conditions so far have been so unfavorable that a precise estimation of its merits has not been made but the Canadian National's intention is to keep the propeller in operation for some time before pronouncing its verdict.

The new marine propeller showing water holes through the blades

This new propeller differs from the standard type inasmuch as the Master propeller has channels cut in the blade in such a way as to eliminate, at least to a large extent, cavitation, which is defined as "a condition in water in which the space immediately behind the propeller is rendered more or less empty by the rapid cleavage of the water by the propeller." Elimination of cavitation will do away with much of the vibration which occurs in present day vessels.

The Master propeller has channels cast in each blade for a distance of about one third of the ridges from the boss. These channels extend from the face of the propeller blade to outlets situated on the face at the rear boss and are so arranged that the water outlet passes between the outer periphery of the boss and the external surfaces of the shaft tail end nut. A suitable opening is provided on the thrust side of the propeller blade. Water passing through these channels fills the space that would otherwise be partly empty due to cavitation, and thus the desired end is achieved.

Since a large proportion of the propeller thrust is waste energy due to cavitation, the idea embodied in the Master propeller is believed to minimize this loss and therefore give a much higher efficiency.

Chemistry Imitates Reptile Skins for Women's Shoes

NEW types of coverings for wooden shoe heels, which are proof against scuffs, have just been developed by the duPont Viscoloid Company. They are made of Pyralin and are produced in a number of opaque colors to match standard leather colors.

The new covering is used not only in plain effects but for obtaining other popular modes. Through this new process, shoe heels may be fashioned in all styles. Embossed designs can be readily applied, producing effects simulating kid or calfskin, and snake, lizard, or other reptile skins. This new method of covering heels permits the making of snakeskin and other leather effects to match the shoe exactly. In obtaining reptilian effects, that part of the leather most suitable for heel coverings is reproduced.—*A. E. B.*

A TOTAL of 250 parents will be behind the public prosecutor in a trial at Lübeck, Germany, in October, which gives promise of becoming famous. These are the parents of children who were killed by "B. C. G." something over a year ago. B. C. G. is the Calmette treatment for tuberculosis and is an attenuated or weakened strain of cultured tuberculosis germs which has been administered to thousands of children in Paris and elsewhere in cases where the parents were tubercular and where there was therefore a likelihood that the children would acquire the disease from them.

The whole affair has attracted much attention within the medical profession, not alone because of the tragedy at Lübeck but because the future of B. C. G. seemed at stake. The Pasteur Institute in Paris, of which Dr. Calmette is Director, claims to have sent to the Lübeck hospital a quantity of uncontaminated culture. It is claimed that the cultures were not correctly made in the German institution. The Pasteur Institute thus far seems to have exonerated itself before the medical profession, but the citizens of Lübeck are not inclined to take the incident lying down, and this is understandable whatever the outcome of the case before the court.—*A. G. I.*

Package Bees

THE industry of raising and selling bees began in California about 1913. Some 400 pounds were shipped in that year. The industry is based primarily on the existing climatic conditions. The spring and summer begins earlier in California. The plants from which bees gather nectar begin to blossom earlier than those of northern and middle-western states. In consequence beekeepers of California build up their

The Canadian National freighter which is testing the new propeller

colonies on the first nectar flow and thus have a surplus of bees to sell.

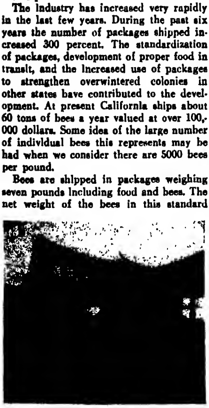
The bee colony is a model of balanced operation. The queen lays her eggs in proportion to the number of workers needed. During the honey flow the life of a worker bee is from six to ten weeks. Figuratively speaking, a bee is born with a definite ability to do work and when its energy is expended the bee dies. At the beginning of spring the queen's laying activity depends upon the abundance of nectar. As the flowers bloom and become plentiful the queen lays between 1500 and 3000 eggs a day, and within six weeks the bees are ready for work.

Young bees emerging from the cell are placed at work in the hive at such tasks as cleaning the hive, and assisting in storing the honey. As they become older they go out for honey. A continual stream of new workers is available as the older bees die off. Thus, if the flowers continue to blossom the honey is gathered by increasing numbers. In case of a dry spell or an interval between flowered crops, the queen lays fewer eggs in order to adjust the number of new bees to the amount of work to be done.

The early spring in California permits the building up of colonies to full strength. A full strength colony weighs 12 pounds or more as compared to an overwintered colony which weighs only three or four pounds. As a rule there is an interval between flower crops, and this permits the beekeeper to divide his colonies and sell the surplus bees.

The industry has increased very rapidly in the last few years. During the past six years the number of packages shipped increased 300 percent. The standardization of packages, development of proper food in transit, and the increased use of packages to strengthen overwintered colonies in other states have contributed to the development. At present California ships about 60 tons of bees a year valued at over 100,000 dollars. Some idea of the large number of individual bees this represents may be had when we consider there are 5000 bees per pound.

Bees are shipped in packages weighing seven pounds including food and bees. The net weight of the bees in this standard



Coating bee cages with syrup to feed the bees upon their arrival

package amounts to three pounds. The use of standard shipping cages which measure 16 by 9 by 6 inches has been adopted, and is in general use by California shippers.

By the use of standard packages and the perfection of food for use in transit, the condition of arrival of bees has been greatly improved. Some years ago only 75 to 80 percent of the shipments arrived in usable condition. At present about 99.5 percent of the bees arrive in good condition.

The shipment of bees in packages is confined to California and such southern states as Alabama, Georgia, Florida, Louisiana, and Mississippi. These two areas, California and the southern states, produce and ship practically all of the bees in the United States that enter into commercial trade.

A recent market survey shows that the markets for California package bees are found in the Canadian Provinces of British Columbia, Alberta, and Saskatchewan, and 11 western states of the United States. Idaho and Utah are the largest consuming areas, with Washington, Montana, and Oregon next.

It is estimated that the total potential demand for California package bees is between three and four times the present shipments. The further development of such markets is dependent upon (1) the reduction of the delivered cost of bees, and (2) the return of honey prices to more normal levels.

The market survey for California package bees was undertaken jointly by F. H.

The cages of bees are crated together with ventilating spaces between

McElfresh, Jr., of the Bureau of Commerce, and F. E. Todd, formerly of the State Department of Agriculture.—*William R. Cage, Chief, Bureau of Commerce, State of California.*

New Plastic from Sugar

UNDER the name "Sakaloid" a new plastic has been announced, the principal constituent of which is polymerized sugar. This desirable combination of a new product and a pure, inexpensive raw material with hitherto restricted use has been reported by a British engineer, Arthur F. Ford, who developed it in a search for a more satisfactory electrical insulating material eight years ago.

The process involves the use of any commercial sugar, molasses, or glucose, which is boiled to a thick syrup, filtered, and then treated with an aldehyde or similar polymerizing agent, with or without the presence of a catalyst, depending on the properties desired.

This product varies from a water-soluble gel to a hard, brilliant, water-white solid which can be molded by casting in open forms or by reducing to shreds and then molding under pressure, either hot or cold. Although experimental results have not yet been released for publication, it is said to have a light-permeability ranging through the ultra-violet, and does not discolor with age, since the transmitted light tends rather to bleach any color that may have been originally present. Pigmentation gives color stability, of course, but eliminates transparency.

By virtue of its mechanical properties, it

Empty bee shipping cage showing the opening for insertion of feed can

can be produced through a long range of flexibility, beginning with the softness and elasticity of crude rubber, and reaching a glassy hardness. Any condition throughout this range can be permanently produced. Machining of all kinds is easily performed, but it also can be supplied in solution for coatings. Furthermore, it can be extruded through spinnerets for artificial fiber. —*A. E. B.*

Nicotine's Enemy, the Sun

THE sun is an enemy of nicotine, it is shown by experiments reported to the American Chemical Society by Dr. K. R. Natarajan of Madras, India.

Five tobacco-curing processes were investigated in a series of tests made by Dr. Pusa, imperial agricultural chemist of India, who discovered that sun-curing reduces the nicotine content to a minimum.

"Dr. Pusa's recent experiments have yielded some very valuable information on the nicotine content of tobacco which will interest cigarette manufacturers and chemists the world over," declares Dr. Natarajan.

"Previous research had already shown that tobaccos cured on racks were better in color and more suitable for cigarette manufacture than ground-cured tobaccos, which were darker and contained a larger portion of volatile nicotine. Now we know that sun-curing will produce the finest results of all, there being an improvement in color and texture as well as an even greater reduction of nicotine."

Investigate New German Cartridge

ORDNANCE officers of the United States Army are investigating the claims of H. Gerlich, German arms inventor, to sensational new velocities obtained with his newest cartridge, enabling a rifle-armed infantryman to put a tank out of action. Steps have been taken to obtain one of his rifles, which will be subjected to tests.

Herr Gerlich is well known as the developer of a line of successful high-velocity sporting rifles, which depend on small-calibered bullets moving at high speeds for their effects, rather than on slower, heavy, smashing missiles. Tests have been made in the past with a .28-caliber bullet at velocities of around 4000 feet a second; the present claim is to an increase in velocity

up to more than 5000 feet a second.

Ordnance officers expressed considerable curiosity and some doubts regarding the price at which such velocities can be obtained with present type rifles and without a radical change in type of propelling powder. Velocities of 5000 feet a second and more can be obtained, even with much larger projectiles than the ordinary small-arms bullet. The long-range gun that shelled Paris during the World War gave a muzzle velocity of more than 5000 feet a second to its eight-inch shells. This velocity, however, was purchased at a price: after about three dozen shots the lining of the gun, particularly near the powder chamber, was so eroded by the in- and pressure of the firing that the piece had to be re-lined.

With present types of steel for barrels and powder for propulsion, this war between powder and gun is bound to be intensified every time the velocity is raised, with inevitably shorter life for the gun. Until American ordnance men can see at least a fairly long life for a high-velocity small-arm such as Herr Gerlich's weapon, they apparently intend to remain on the fence.—*Science Service.*

To illustrate the tenacity of asphalt to oil-coated stone, the stone at left was oil-coated and the one at right uncoated. When they were pulled apart, the asphalt pulled away from the uncoated stone and left a bone-dry surface

Oil Coating of Stone in Pavements

THE discovery and demonstration in the road laboratories of Warren Brothers Company, Boston, Massachusetts, that asphalt will penetrate the mass of stone in a street pavement much more evenly when the stone has been previously oiled than when the stone is unoiled promises much for American highways in the creation of a durable yet inexpensive highway pavement. It also was found that the asphalt will adhere more strongly to the oiled stone and more completely cover oiled stone than unoiled stone, thus binding the stones of the pavement more strongly together.

In the laboratory tests, from 15 to 20 percent of the asphalt poured on a three-inch layer of unoiled stone in a test pan, at a rate of two gallons per yard, was found to escape to the bottom of the layer and to fall through the perforations in the bottom of the pan. Only 2 percent of the asphalt was found to reach the bottom of the pan when the stone had been previously oiled. It was found that the asphalt adhered much more strongly to the half of a stone which had been oiled than it did to the unoiled half.

It was also found that when asphalt is poured over a layer of stone that has not been oil-treated, the asphalt naturally covers the tops of the stones, and then drips over the edges as vertically as possible considering the position of the adjacent stones. The sides of the stones are only partially coated with asphalt or are not coated at all. Similar tests using oil-coated stone show that the asphalt follows the oil film, coating the sides of the stones as well as the tops. In all tests the same kind and quality of stone was used. In the tests with the stone that had not been coated with oil, a soft asphalt such as is commonly employed in asphalt macadam roads to secure greater penetration of the stone mass, was used. But the oil coated stone was poured with a hard asphalt, with greater cementing strength. This was made possible by the oil film on the stone.

The explanation of the results of these experiments lies in the fact that the oil offsets the effect of the dust or moisture present on the surface of the stone; the asphalt cannot obtain a good "grip" or adherence to stone which is moist, or dust coated.

This apparently simple, though valuable discovery, means that the cementing strength of the asphalt in street work is thereby greatly increased. The asphalt adheres strongly and completely to the stone and consequently effects a strong binder, stone to stone. In cold and wet weather, ravelling may occur in asphalt macadam, where stones are unoiled, due to insufficient adherence of the asphalt to the stone and consequent breakage of the stone bond. If fissures develop in the surface and water penetrates into the street pavement, the raveling may develop into a hole. In warm weather asphalt macadam may show a tendency toward "bleeding" caused by the movement of the stones under traffic, squeezing pocketed asphalt to the surface. This results from the asphalt's uneven distribution. Waving of the surface of the pavement is due to lack of stability of structure, largely because of the soft asphalt used.

In the new process which has already been applied in a number of states, the oil coating is reported to prevent ravelling and excessive movement of the stones, and to lessen "bleeding." Briefly, this construction consists in providing a layer of oil coated stone which is compacted sufficiently to prevent serious rutting by the trucks used to convey materials to the work and then coated in place with a bituminous cementing medium in the usual manner. After the asphalt has been applied to the first layer of stone, a very thin layer of oil-coated smaller stone is spread and compacted in place, thus keying the larger stone firmly in position. This layer of smaller stone is then coated in place with asphalt. Finally the top is covered with a thin layer of oil-coated small stone.

New Microporous Rubber Makes Unique Absorbent

H. BECKMAN, of the Technische Hochschule, Hanover, Germany, discussed a new product—microporous rubber—at a recent meeting of the Deutsche Kautschukgesellschaft, in Eisenach. With respect to hardness, microporous rubber is similar to paper pulp, or perhaps soft chamois. It is characterized by extreme fineness in physical structure, and is penetrated by innumerable pores, which have an average diameter of about 0.0004 of a millimeter. The material can absorb moisture equivalent to about 60 percent of its vol-

The test pan at the left was filled with uncoated stone and the one at the right with oil-coated stone. When asphalt was poured over the stone in both pans, it clung to the coated stone but much of it leaked through the other pan

ume. Under the name "Mipor-Schelder," it finds application as diaphragms in the accumulator industry.

In the chemical industry Mipor-rubber is used as a covering for large filter presses. Because of its resistance to oil, this new material is useful as a packing to supply the bearings of ships and machinery uniformly with lubricant. Sheets of microporous rubber are suitable for blotters, and can be used for sanitary purposes, since they may be sterilized by boiling. Inasmuch as it can be dyed easily, microporous rubber may be used for veneering and wall covering. In the form of hard rubber it may be pulverized and used in air and water filters, and so on.—*A. E. B.*

Temperament and Health May Be Linked

CERTAIN physical make-ups are associated with certain types of temperament, it is indicated by a report made recently to the Association of Consulting Psychologists by Drs. L. P. Herrington and W. R. Miles.

Of a group of 550 Stanford University men, it was found that those classed by psychologists as introverts, or having a self-centered personality, had less athletic ability, had required more medical service and had undergone more major surgical operations.

The investigation was made by Dr. Herrington at Stanford, under the direction of Dr. Miles, who was then at Stanford, but is now spending his sabbatical leave at Yale's Institution of Human Relations.—*Science Service.*

Stainless Steel in the Navy

THE gasoline storage tanks for the Navy's new airplane carrier, largest [illegible] and for scout cruisers *Portland* and *Indianapolis*, as well as for four cruisers now being built in government Navy yards, are to be made of Allegheny metal, the non-corroding chromium-nickel-steel alloy.

It is the practice to pump sea water into these tanks as the gasoline is drawn off, in order to preserve the trim of the ship. The gasoline floats to the top of the water and is readily drawn off as needed. A metal that will withstand the action of the salt water is required, and the Navy department specified the chromium-nickel-steel alloy sometimes known as "18 and 8."

The new airplane carrier, which will surpass in size the *Saratoga* and *Lexington*, at present the largest vessels of this class, is being built by the Newport News Shipbuilding Co. The *Portland*, now known as *Scout Cruiser 33*, is being built by the Bethlehem Shipbuilding Corporation and *Scout Cruiser 35*, which will be named the *Indianapolis*, by the New York Shipbuilding Co. Contracts for the gasoline storage tanks for these ships, as well as for the four cruisers being built in government yards, were awarded to the Blaw Knox Company of Pittsburgh, Pennsylvania, which is furnishing Allegheny metal, the product of the Allegheny Steel Company of Brackenridge, Pennsylvania, on all seven jobs. The airplane carrier will have 12 of these tanks and the cruisers two tanks each. The 20 tanks will require about 175,000 pounds of the alloy.

A Motor Boat Built on Airplane Principles

THE modern high-speed motor boat, traveling at top speed resembles an airplane far more than a boat, because it depends on the dynamic reaction of the water for its support, rather than on water displacement.

Thomas E. Lake has gone a step farther. He has frankly accepted the application of airplane principles to water craft and has successfully constructed a hydroplane-float boat. The body of the boat is truly a seaplane fuselage, housing the occupant, fuel tank, and so on, but having no contact with the water. A powerful outboard motor is placed ahead of the operator. Three hydroplane floats are provided. Each side float is carried at the end of a short "wing." These two floats can, by suitable mechanism, be tilted about the longitudinal axis of the craft. Their sideways tilt gives more "lift" on one side and less "lift" on the other. Therefore they act just like the ailerons of a flying machine and can "bank" the craft. The float at the rear can be turned and therefore acts as a rudder.

The Lake hydroplane with a boat distinct from its three supporting floats. The side floats can be turned to "bank" the craft on sharp turns

While tests must be awaited before a definite conclusion as to the utility of the new craft can be made, it does seem as though Mr. Lake has possibly achieved something really worthwhile.

Since his flotation system is divorced from the passenger body, he can design the flotation system for its purpose, and the body for its purpose, thus achieving maximum efficiency with both. The body can be aerodynamically streamlined (which is important for racing purposes), and the floats can be designed for most effective lift with little water drag.

Since the two side floats are so far apart and since the rear float is so far behind, there will be provided a maximum stability both laterally and longitudinally. Here is a real safeguard against

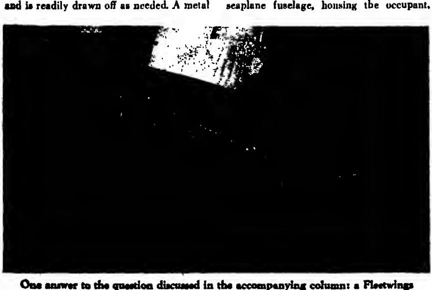
To make a fast turn it is necessary to "bank," but here the bank would be controllable at the will of the pilot.—*A. K.*

Dural or Stainless Steel?

FOR some time it was thought that duralumin, the high strength aluminum alloy, would replace wood on the majority of airplanes, but now stainless steel is proving to be a strong competitor to dural in metallizing the airplane. Dural has a tensile strength of 55,000 pounds per square inch and weighs about one third as much as steel. But the new stainless steels, such as Allegheny metal, which is an alloy of steel, chromium, and nickel, have a tensile strength of 190,000 pounds per square inch. Therefore stainless steel is stronger, weight for weight, than dural.

Another great advantage of Allegheny steel is that it is non-corrosive and, therefore, requires no coating of any kind. A third advantage claimed is that the steel receives its high tensile strength from cold working, not from heat treatment, and therefore it can be obtained from the mill with the required physical strength and does not require heat treatment after fabrication into spars or other airplane parts.

We illustrate a cantilever monoplane wing built with real success by Fleetwings. Every part of this wing is of chrome-nickel



One answer to the question discussed in the accompanying column: a Fleetwings cantilever wing built of the strong, non-corrosive Allegheny metal. The structure is very strong despite its lace-like delicacy and apparent fragility

steel, and fabrication is by a process of spot welding, for which less skill is required and more regularity is claimed than for oxy-acetylene welding. The metal is supplied in the form of thin strip, 8 to 12 thousandths of an inch in thickness, which is drawn into tubing or simple U channels. Thinner gages of metal are used at the tip of the wing than at its center where loads are heavier. The spars are built of two channels, one top and one bottom, with two side webs of strip, punched with holes to lower the weight. The photograph indicates the almost lacelike delicacy of appearance of this type of construction, which is nevertheless extremely robust because of the inherent strength of the material employed.—*A. K.*

Electric code beacon flasher which identifies an airport by flashes sent in the International Morse Code

Airport Code Beacon Flasher

THE Department of Commerce requires that definite code signals must be flashed by the auxiliary beacons at airports. Where more than one International Morse Code character is assigned as the symbol for the airport, the symbol can not be flashed by a cam on the rotating beacon if the duration of the complete cycle of flashes is more than 10 seconds.

In a new type of flasher developed by the General Electric Company there is embodied a cam which revolves once a minute, allowing more than sufficient time to flash any combination of two or three characters. Accurate timing of the code character cycles is assured by a Telechron motor, similar to that employed in Telechron clocks. In operation, the cam shown in the photograph actuates silver contacts which close the circuit in a contactor, and this, in turn, closes the circuit to the two lamps in the auxiliary beacon. The whole apparatus is enclosed in a compact steel cabinet, six inches square.—*A. K.*

A Portable Mooring Mast

IF airships are to navigate as freely and as unrestrictedly as airplanes, they must be freed from the restrictions of mooring masts, large handling crews, and so on. Realizing this fact, the Goodyear-Zeppelin Corporation has developed what may be termed a portable mooring mast, which is illustrated in our photograph.

The mobile mast or "traveling harbor," as it has been picturesquely named, consists of a tripod adjustable to a height of 10 to 12 feet and is mounted on top of a ground-crew bus. At the top of the mast is a groove into which a locking device, built into a 16-inch disk in the forward part of the ship, is slipped and fastened. The mast has been given thorough tests and the mooring operation has been effected several times in less than a minute. A Goodyear airship attached to this mast can outride a 35- to 40-mile wind in safety, as the ship can pivot around the bus in response to the buffeting of the wind.

When not in use the mast is folded and clamped down to the roof of the bus, the out-riggers being detached and packed inside the bus in the rear. The bus provides substantial anchorage for mooring the ship, as without a load it weighs more than three tons and when carrying the usual cargo of bags of sand and an outfit of tools and the crews' baggage the total weight is approximately five tons.—*A. K.*

An Invention Needed to Beat Fog

IN a paper presented before the American Society of Mechanical Engineers, Dr. S. Herbert Anderson disclosed the results of some extremely valuable experiments on fog penetration, in which he used a large chamber filled with artificially created fog.

Fog particles are minute particles of water of from one to ten microns in diameter, a micron being about 1/25,000th of an inch. The fog droplets non-selectively reflect and refract the rays of light. A haze will let the red rays through somewhat better than other rays; that is why the sun appears to be so red through a haze. A fog, composed of larger particles than haze, acts non-selectively, nothing gets through, and impenetrability results.

When we consider how thoroughly fog will blanket the sun or a powerful beacon, it is surprising how little actual moisture there is in a fog. Were all the water from a stratum of fog a mile thick to be collected into a layer it would only be 1/25th of an inch thick, yet this finely distributed fog can prove to be a great hazard to flying.

A short while ago it was thought that red or orange rays would penetrate fog better than other components of the spectrum. The experiments of Dr. Anderson and other scientists have shown conclusively, however, that the shorter wavelengths of the spectrum (violet), the medium wavelengths (blue, green, and yellow), and the longer waves (red) all fare about alike. Moreover the red rays have to be more intense to produce sight perception. Therefore the use of red or orange beacons is based on a fallacy.

Dr. Anderson also made this striking discovery: The very short ultra-violet rays, and the very long infra-red rays, both invisible to the eye, both penetrated the fog better than the visible components of the spectrum. More of the infra-red rays than of the visible rays are produced by an ordinary light source.

Why not therefore devise an instrument which will be sensitive to the infra-red rays and thus extend the utility of the airway beacon many times?

An infra-red beacon has certain definite advantages for localizing purposes. The same methods of projection can be used as for light beacons and flood-lights. Infra-red beams are not affected by local electrical disturbances. The power source for infra-red beams consists of standard electrical equipment.

At present only very sensitive laboratory methods of picking up infra-red radiation are available, far too delicate for aircraft use.

Here is a splendid opportunity for some one to devise practical instruments for flying use!—*A. K.*

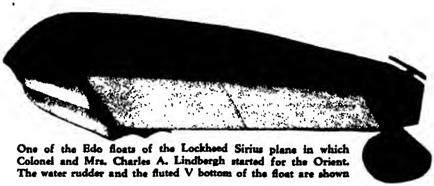
A New Non-Corrodible Alloy

BATTERIUM metal, a new copper-aluminum-nickel alloy, introduced by Batterium Metal and Vislock, Ltd., of Market Harborough, England, is claimed to be an ideal acid-resisting metal for the construction of stills, fractionating columns, solvent extraction and solvent recovery plants, and also for chemical plant use generally. It is suitable for use in contact with organic acids, alkalies, superheated steam, and bleaching and dyeing liquids. Particulars of tests on the action of various

The "traveling harbor," or portable mooring mast for small dirigibles

corrosive liquids on this metal are contained in a leaflet which has been issued by the makers. These tests were carried out at the Royal Technical College, Salford, together with Monel metal, Staybrite steel, and electrolytic copper as materials providing a standard of comparison.—*A. E. B.*

Lindbergh's Latest Equipment



One of the Edo floats of the Lockheed Sirius plane in which Colonel and Mrs. Charles A. Lindbergh started for the Orient. The water rudder and the fluted V bottom of the float are shown

THE opinion is often expressed that Colonel Lindbergh is tempting fate by his many bold flights, sometimes in uncharted territory, and that an accident to him and Mrs. Lindbergh would be a disaster for American aviation in particular and for the country in general. It will be found, however, that Colonel Lindbergh, while bold, exercises the greatest care in all his plans.

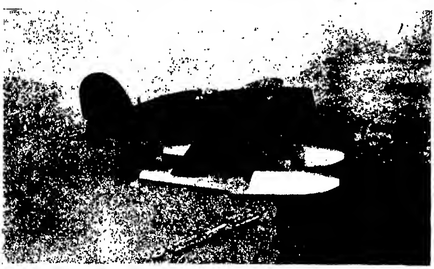
At the time of writing, Colonel and Mrs. Lindbergh have left on their latest goodwill flight—this time to the Orient. As usual, the Colonel's preparations were excellent and the equipment used merits special study.

For his plane he has selected the speedy Lockheed Sirius, equipped with the latest type of floats. The Sirius is a low-wing monoplane, painted reddish orange and black, and powered with a Wright Cyclone engine, which, with a special supercharger, develops 680 horsepower at 2100 revolutions per minute. The wing span is 42 feet 10 inches; overall height from the bottom of the pontoon step to the top of the cowling is 11 feet 4 inches; and the overall length is 29 feet 11 inches. The design load with 400 gallons of gasoline is 6400 pounds. With a gross load of 6800 pounds—that is 400 pounds over the design load—Colonel Lindbergh took the plane off the water in only 41 seconds. The top speed of the plane is said to be about 170 miles per hour, though it is probable that the careful pilot will only cruise at 125 miles per hour, sparing his engine as far as possible for its long task. At this speed, the gasoline consumption will be 32 gallons an hour, so the flying range will be 1500 miles, long enough for every part of the trip with reserve gasoline to spare.

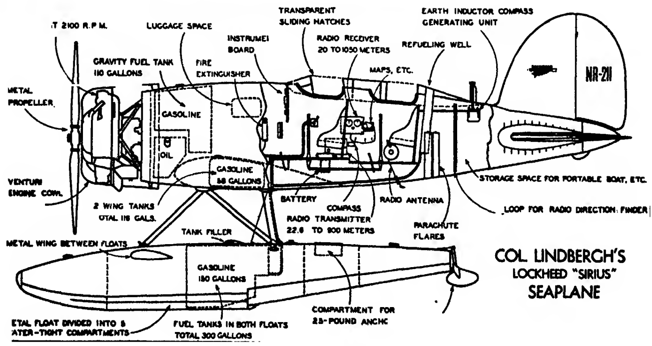
Five gasoline tanks are carried. The gravity feed tank behind the engine has a capacity of 110 gallons. Two wing tanks can carry 58 gallons each. In each of the two floats there is provision for 150 gallons. Behind the rear cockpit there is a special refueling well, placed high above the water, an obvious precaution for refueling under difficulties.

Colonel and Mrs. Lindbergh are both licensed radio operators, and their craft has been provided with both receiving and sending sets. The radio antenna can be unwound from a reel placed under the rear seat. The cockpits can be protected against weather by the use of sliding transparent covers over the cockpits. The equipment also includes a full set of instruments, an earth inductor compass, and parachute flares. At the rear of the fuselage there is carried a collapsible boat, with an emergency wireless set, and compressed rations.

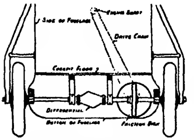
Not the least interesting part of the seaplane is in the set of new Edo floats, claimed to have the least aerodynamic re-



At the beginning of the flight: Colonel Lindbergh on his way to Maine to see his son before the flight across Canada. *Below:* Equipment of the fast plane



sistance of any float for a given displacement. Their form approaches closely the ideal aerodynamic form, that of an airship. Another interesting feature of the Edo float is the sharp V bottom, the sides of which are at an angle of 30 degrees, whereas the usual commercial float has an angle of only 15 degrees. The sharp V naturally lessens the shock of a water landing, but when the



Possible mechanism of the plane of the future which will travel to the landing field under its own power

V gets too sharp, there is difficulty in planing on the step just before take-off, and the take-off period becomes both longer and more difficult. In the new Edo float the bottom is fluted, presenting four distinct surfaces. It is this fluting which allows the sharp V to be used without impairing the planing qualities.

The automatic water rudders are attached to the transom of the float with a horizontal as well as a vertical hinge and connected to the main air rudder controls through the use of springs. They lie well below the bottom of the floats when in the air or when taxying on the water at speeds low enough to require their use, but automatically rise out of the water when higher speeds are reached. This feature of automatic reefing provides a safeguard against over-control at landing or take-off speeds.

Another valuable feature of the flotation system is that the main cross-bracing member between the floats is itself of airfoil form, and therefore contributes to the lift —thus more than compensating for its air drag.—*A. K.*

Has the Airplane a Future?

WRITING in *Western Flying*, J. W. Miller states that aviation has a future provided that we remember the old pioneer spirit of the country and use courage and imagination. To make flying truly accessible to the public, he advocates certain very definite steps. Highway appropriations should be increased by 1 percent, and intermediate landing fields at 15-mile intervals should be built along all primary highways. These intermediate fields would need only five to eight acres and cost some 9000 dollars each.

The airplane should be designed to be really useful to the private owner. Lower landing speeds should be provided. It should be possible to fold the wings with a very simple mechanism. The tail skid should be replaced with a steerable tail wheel and means should be provided for disconnecting power from the propeller and applying it to the wheels. We would then have a vehicle that could reach the flying field from a garage under its own power.

Granted this question of emergency fields settled and a plane designed for popular use, Mr. Miller foresees a number of important sociological effects in the life of the nation.

Decentralization of our homes would follow very quickly. Delivery zones of department stores would be greatly extended. Location of factories and warehouses would be outside of cities.

Mr. Miller is imaginative but certainly plausible.—*A. K.*

Statistics of Flying Safety

THE · · srial Society of America, a reliab :hority on safety statistics, has :ently published a comprehensive report on flying safety. The report states that for the year 1929 the flying fatality rate was approximately 1 death per 3,000,000 passenger miles. In 1930 there was a death rate among airway passengers of 1 death in 17,396 passengers carried, the average length of a trip being about 250 miles. This develops into a rate of 1 death for each 4,300,000 passenger miles, a decided improvement over 1929. The later half of 1930 showed still better figures, and for the year ending March 31, 1931 the rate was 1 death in 9,000,000 passenger miles.

Husky police dogs are vigilant guardians of a museum's treasures

It is interesting to compare this last rate with the death rate for other methods of transportation: For railways the rate is 1 death per 40,000,000 passenger miles; for street railways, 1 death in 455,000,000 passenger miles; and for automobiles, 1 death in 20,840,000 passenger miles.

It would appear that passenger flying on scheduled routes is now about half as safe as travel by automobiles. This is quite encouraging, particularly as airplane travel is constantly improving in safety.

The Department of Commerce analyzes the reasons for increased flying safety in the following terms:

"The close adherence by operators to the department's regulations prohibiting the flying of scheduled interstate air-transport planes carrying passengers for hire, below an altitude of 500 feet; the excellent quality of American designed and built aircraft and engines, coupled with their conservative and skilful operation and maintenance by pilots and mechanics with years of experience behind them; the assistance rendered by the Department through its 15,000 miles of lighted airways, 354 intermediate landing fields, radio-beacon service, radio weather broadcasts to planes in flight, and an extensive system of collecting and disseminating aeronautical weather information through automatic telegraph-typewriter circuits."

All this goes to explain the increasing popularity of airway travel by the American public.—*A. K.*

Museum Watch Dogs

A NEW and successful method of protecting its treasures is employed by the Museum of Fine Arts in Boston. In addition to the regular watchmen, two German police dogs are now being used.

In this Museum there are two shifts of watchmen and a foreman. The first shift is on duty from 4 P.M. until midnight, the second being on from midnight until 8 in the morning. The foreman who makes the entire round of the Museum during each period, is accompanied by one of the police dogs which, because of his animal instincts, would be able to sense the presence of thieves much quicker than a human being.

One of the dogs serves with the first watch and the other dog with the second watch, but when the first dog is "off duty" he remains in the central office with the man on guard there. The tour of the Museum for each dog measures nine miles and in spite of the strenuous nature of their work they are on duty seven days a week throughout the year.

Steamer Hauled Up a Mountain

"IT took nine trains to pull the parts of the ship, *Ollanta*, up the Andes Mountains to Lake Titicaca," said L. S. Blaisdell, General Manager of the Southern Railways of Peru, to a representative of the Pan-American Union.

Courtesy L. S. Blaisdell, Southern Railways of Peru

The steamer built for service on Lake Titicaca, 12,500 feet above sea level

"Following our company's policy of endeavoring to give the utmost value in service, it was found desirable to augment our fleet of steamers on Lake Titicaca. The new vessel, the *Ollanta,* was constructed at Hull, England, and shipped aboard the S. S. *La Paz* to Mollendo on the coast of Peru. Discharge of cargo by lighter took place there and then the first of nine trains began hauling the *Ollanta's* parts up the steep grades of the Andes 300 miles to the shore of Lake Titicaca. The railroad crosses the crest of the mountains at an altitude of 14,688 feet and then the descent is made to the shore of the lake, which is 12,500 feet above sea level.

"The vessel is now in course of reconstruction on the company's slipway at Puno, which is the only modern type slipway in South America. The *Ollanta*—which means 'the great Inca general'—is 265 feet long and will have accommodations for 66 first-class passengers. There will also be much cargo space. She will be an oil-burner."

The first steamer to navigate Lake Titicaca, the *Yavari,* was transported piece by piece by mule-power from the Pacific coast in 1863, before the construction of the railroad. That was a stupendous task and required many months. Other small steamers e brought from England from time so that today passengers and freight are quickly transported over this great body of water.

With the completion of the *Ollanta* the last word in modern steamer service will be achieved. "In this connection," says Manager Blaisdell, "the vessel will satisfy the taste of the most fastidio and luxu- s of big o

Cheap Alloy Sought for Turpentine Cups

THE turpentine industry needs a durable and inexpensive cup for gathering turpentine gum, a cup which will neither rust nor discolor the gum. At the request of the Pine Institute of America, chemists of the United States Department of Agriculture have been testing cups made from various substances and of several alloys. The Bureau of Chemistry and Soils reports that several months of investigation have not yet revealed a cup material which is both inexpensive and satisfactory, but that the search will continue. Some of the alloys tested resist the chemical action of water and turpentine gum, and do not discolor the gum objectionably, but these alloys are too expensive. Cups made of 26-gage plate, the investigators say, would cost about 25 cents each, or 2500 dollars for a "crop" of 10,000 cups, an expense which producers cannot undertake.—*A. E. B.*

Chemical Treatment Doubles Life of Fishing Tackle

ONE would hardly expect to find chemistry applied to fishing, yet that science is playing no inconsiderable part in the fishing industry today. In New England, for example, where fishing is a major industry, the nets, lines, and other fishing equipment have an exceedingly short life, so one of the major problems is the preservation of nets and lines. When the value of the cordage gear used by the

New England fishermen—4,000,000 dollars—is compared with the value of the annual catch of fish and shellfish, which is about 25,000,000 dollars, it is seen that the length of life of the gear is a very important factor in the cost of catching sea foods, especially when one considers that many nets wear out in one season, and most nets last less than two seasons. Clarence Birdseye points out this problem in a recent issue of *Chemical and Metallurgical Engineering*.

Until 1919 no scientific investigation of chemical preservatives for nets, twines, and ropes had been carried out in this country. In that year the United States Bureau of Fisheries began a comprehensive study of means of lengthening the period of usefulness of these important tools of the fisherman. These investigations, which are still being continued, have brought to light an important new preservative for nets and twines: copper oleate. This chemical, when used in combination with coal tar, has been demonstrated to be an excellent preservative of tensile strength of cordage gear. Treated with this combination of preservatives, netting often lasts twice as long as that treated with proprietary preservatives. —*A. E. B.*

Traction Booster Assists Braking

THE old adage that a man cannot lift himself by his own boot straps has lost some of its significance since a device was developed for street cars by the Westinghouse Air Brake Company called the "Traction Booster"—an auxiliary to the air-brake system.

This device, as its name suggests, "boosts" or increases the traction (adhesive friction) between the wheels of a car and the rails, without actually increasing the weight of the car, the purpose being to permit application of greater retarding force in order to shorten stopping distances.

While a man cannot decrease his weight on the ground by an upward pull on his boot straps (this merely increases the pressure between the soles of his boots and the soles of his feet) provision is now made so that a car can increase its own weight, that is, in effect, for the purpose in mind, by pulling itself down to the rails with greater force.

Ordinarily, a car is held to the rails by the pull of gravity alone—its own weight. By means of the "Traction Booster" it may be held to the rails with an additional *magnetic* pull. The advantage of this will be evident by a review of the following facts.

Consider first what stops a moving car. When the brakes are applied each wheel thrusts forward on the rails with a force equal to the brake shoe friction, which is opposed by an equal backward thrust of the rails against each wheel. This force acting in opposite direction to the motion of the car, causes retardation. The shortest possible stop is produced when the forward wheel thrust almost, but not quite, equals the maximum rail resistance, which is determined by the adhesion between wheels and rails. In other words, the total brake-shoe friction (pressure times coefficient of kinetic friction) must not exceed the rail adhesion (weight times coefficient of static friction), or wheel sliding will occur. (Automotive vehicles have a natural advantage over street cars in stopping ability, because of greater traction, since the coefficient of friction between rubber tire and roadway is higher than between wheel and rail.)

Since this rail friction is thus inherently restricted by the nature of the materials in rolling contact, and the braking force thereby limited, the only remaining way to increase traction and permit greater retardation is to increase the other factor involved, the weight, which is done by the "Booster."

This device utilizes magnetic attraction between the truck frame and rail for accomplishing its purpose. As may be seen from the illustrations, magnetic shoes are suspended between the wheels directly over the rail. When a predetermined air-brake cylinder pressure has been built up, a pneumatically-operated switch energizes the coils of these shoes, causing the latter to move toward, but not upon, the rail. This powerful magnetic attraction is equivalent to increasing the load on the rails without actually increasing car weight. Advantage is taken of the greater traction thus produced to increase the braking force of the air-brake system. Since length of stop is inversely proportional to the amount of retarding force, shorter stops naturally result.

It should be emphasized that no retardation is produced by this magnetic attraction. The shoes do not come in contact with the rail. Full control of braking p is retained by the air-brake system, thereby allowing its inherent flexibility to be exercised. These features differentiate the "Booster" from the magnetic brake which was in use a quarter century ago, but very largely abandoned as impractical due to high maintenance expense involved and the extreme variation of braking pressure due to voltage fluctuations. As the "Booster" shoes do not ride the rails, damage to them from cross-overs will not occur

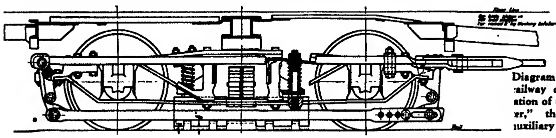


Diagram of a truck of a railway car showing installation of the "Traction Booster," the electro-magnetic auxiliary to the brake system

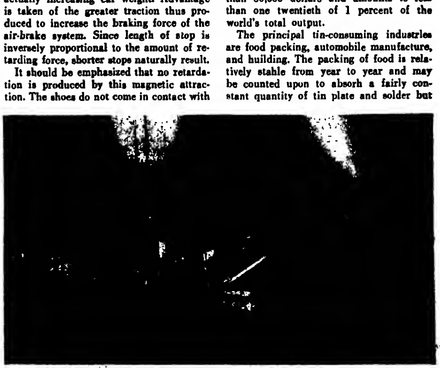
Normally, a retardation of but 3½ miles per hour, per second, is about the limit, whereas with this "Booster" a retardation of 7½ miles per hour, per second, has been attained without wheel sliding.

In addition to the advantages of the "Traction Booster" during deceleration, it can be used to advantage in acceleration and assist materially in the ascent of steep grades.

U. S. Consumes Half World's Tin, But Produces Negligible Quantity

TIN is the only metal of which the United States annually consumes more than 20,000,000 dollars worth and yet remains a negligible producer, points out the United States Bureau of Mines. In fact, the value of the tin annually imported for consumption ranges from 60,000,000 to over 100,000,000 dollars and accounts for almost half of the world production. Annual domestic production is valued at less than 50,000 dollars and amounts to less than one twentieth of 1 percent of the world's total output.

The principal tin-consuming industries are food packing, automobile manufacture, and building. The packing of food is relatively stable from year to year and may be counted upon to absorb a fairly constant quantity of tin plate and solder but

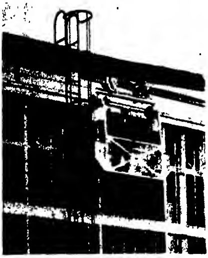


On this truck between the wheels is installed the "Traction Booster" which, by attracting a railway car to the rails, increases its effective traction

the automobile industry is subject to wide variation in the number of units produced, says Charles White Merrill, in a recently issued Bureau of Mines report.

If the recovery of secondary tin—that is, the production of tin from sources other than ore—were included with primary production, the United States would rank third among the tin-producing countries of the world. Tin-bearing alloys, tin-plate clippings, and melting-pot drosses are the most important materials from which tin is reclaimed. Most of the tin recovered from alloys does not pass through a refined-tin stage but is made into alloys which are brought to the required specifications by the addition of virgin metal.

Much study has been given to the problem of finding a substitute for tin plate in



Trolley cars which travel on rails encircling a building of the General Electric Company, carry hot and cold water for window washing. The cars may also be raised and lowered

the anning industry, but no tin-free container has heen developed as yet that can offer serious competition to the tin can. Glass containers have been used successfully where the advantage of display of contents has outweighed the higher initial cost and the difficulties of transportation. Experiments have been ith stainless steel cans, but the high d difficulties of opening have made their use un nomical. Research to develop a pract aluminum can continues. Research in substitution of lacquers for tin in manufacture of tin cans has made li progress because of the difficulty in taining an appearance of beauty equal to that of the tin, as well as the difficulty in duplicating the purely utilitarian qualities of the tin coating.

Aluminum is being used as a substitute for tin in the manufacture of foils and collapsible tubes. Moreover, tin foil is meeting severe competition as a food and cigar wrapper in cellophane, a transparent cellulose product, and in various waxed papers.—*A. E. B.*

Chemical Accident Record for 1930

ACCORDING to statistics compiled by the National Safety Council, the record of industrial accidents during 1930 shows that workers in the chemical industry are no more subject to injury than the em-

ployees of other industries. In a list of 28 major industries, the chemical industry ranked tenth on the basis of its frequency rate and fourteenth in severity. Accidents were most frequent in coal-tar distillation plants and most infrequent in plants manufacturing carbon products. The severity

Front and side views of a foetus into the arteries of which an opaque material has been injected. This radiograph illustrates the effectiveness of the new radiographic technique discussed in the column below at left

rate was lowest for industrial gases and highest for explosives.

As chemical plants increase in size, their injury rates decrease, a situation more or less common to plants in all industries. None of the groups employing less than 749 people had a frequency rate less than the average of 15.50 and none of the groups with less than 499 employees had better than average severity.—*A. E. B.*

A New Radiographic Technique in Biology

WHAT is claimed to be a valuable biological procedure, the injection of opaque material into the arterial system of human and animal specimens, followed by the use of the X ray for making radiographs which then display the arterial system to better over-all advantage than is afforded by the usual method of dissection, has been developed by Arthur W. Fuchs of the Eastman Kodak Company.

For the average person and student, dissection is a difficult procedure demanding training, experience, and a certain degree of aptitude. A pair of Mr. Fuchs' radiographs is reproduced in these columns. These show the complete opaque injection of the arterial system of a five months' foetus, made through the umbilical cord. The arterial system is seen to be almost diagrammatic. By the combination of radiographs taken from various directions the complex system of arteries is made simple at once.

The procedure is that of injecting a suspension of lead oxide in olive oil and xylene into the blood vessels after death.

Doubtless this method of making the invisible clearly visible could be adapted to other uses than the one described—this, at least, has been the history of the majority of newly developed methods.

Car Driver's Posture Influences Fatigue

FATIGUE in driving an automobile is due to poor posture as well as to improper springs, shock-absorbers, and other defects in the car, according to medical and other authorities. Dr. Dudley B. Reed, professor of hygiene and director of the Health Service of the University of Chicago, declares that slumping down in the seat, and other mistakes in posture, when riding or driving, by restricting the natural functioning of the lungs and other organs, is a direct cause of unnecessary fatigue; pressure under the knee, due to too deep a seat or to other causes, subjects the nerves to pressure that may result in serious disorders.

Dr. Reed and other authorities agree that good posture is a health and safety measure as well as a means of greater enjoyment and they declare that properly designed and upholstered seats are essential to proper posture. In this connection, Dr. Reed declares, "I feel that one can maintain correct posture more easily under riding conditions if the upholstery is of such a material as mohair rather than of smoother and more slippery material."

Here are the chief essentials of correct riding or driving posture as presented by Dr. Reed and by Dr. Bennett, director of educational research of the American Seating Company: The person who would ride comfortably, safely, and with the least danger of unnecessary fatigue, should sit well back in the seat with the weight resting chiefly on the seat bones, on a point below the shoulder blades, at the top of the hips to help support the back, and on the feet. It is extremely important that there be no pressure under the knee. The correct posture, experts agree, is the one that gives the greatest relaxation and comfort, permits the greatest freedom of arms and legs, and keeps the body poised in a position where response in case of emergency is easiest and quickest.

Pellagra Due Wholly to Foods

IT has been definitely established that pellagra is strictly a dietary disease, which may be uniformly produced or prevented at will by simply varying the quantity of the foods which carry the antipellagric vitamin, the United States Public Health Service declared in a statement recently.

The United States Public Health Service states that although pellagra has been known to be more or less prevalent in certain sections of Europe for nearly 200 years, and in this country for almost a quarter of a century, it is only recently that the nature of its cause has been made clear and practical and effective measures for its treatment and prevention have been established.

Pellagra is unlike most preventable diseases with which we have to contend, as infection appears to play no part whatever in its causation, and the sanitary and hygienic measures commonly employed against transmissible diseases offer no aid in its control.

It has been abundantly demonstrated that pellagra may be uniformly produced or prevented at will by simply varying the quantity of the foods which carry the antipellagric vitamin—vitamin G. This occurs without regard to the quantity of other foods consumed which, except for the shortage of this particular vitamin, may be in perfect physiological balance. It is therefore seen that pellagra, like the other vitamin deficiency diseases, is brought about by the absence of a specific and essential dietary factor and is in no way dependent

With spines erect, their bodies supported at the shoulders, a point above the hips, on the seat bones, and on the feet, these girls will r

upon starvation in the ordinary sense as is frequently assumed.

The various foods and foodstuffs have been found to differ widely in the quantity of the antipellagric vitamin which they supply, and this makes variety in diet of the utmost importance in the treatment and prevention of pellagra.

Some foods, such as fresh lean meats, liver, milk, canned salmon, and commercial wheat germ, have been found to be

that the addition of a reasonable quantity of

effectively supplement an otherwise pellagra-producing diet.

Other foods, including eggs, canned haddock, dried peas, soy beans, dried milk, and tomatoes, have been found to possess considerable protective value, but must be consumed in relatively large and often excessive quantities when depended upon as the only or principal source of vitamin G, while still others, including corn products, wheat flour, rye flour, oatmeal, salt pork, lard and the commercial lard substitutes, butter, carrots, rutabaga turnips, mature onions, sweet potatoes, molasses, and white rice are such poor sources of this vitamin that they cannot be depended upon, regardless of the quantities or combinations consumed.

Fortunately, in most sections of the country the diet is composed of a sufficiently large variety of foods to insure a fairly adequate supply of the pellagra-preventive vitamin at all seasons. Under such conditions pellagra appears only sporadically, if at all, and usually results from dietary id-

and eccentricities, or other

Substance of Digestive Juice Prepared Pure

THE stomach's digestive ferment dissolves the starch in foodstuffs makes it available for the energy of the body has been prepared in the pure state for a first time in the chemical laboratories of Columbia University. This marks an important step toward finding out what these complicated ferments really are, a problem that has hitherto remained unsolved because they could not be obtained pure.

Professor H. C. Sherman, who is well known as an authority on the vitamins, and two associates, Professor M. L. Caldwell and L. E. Booher, announce their accomplishment in a report to the journal *Science*.

Starch, under the action of this ferment, is converted into malt, this being also the first step in the preparation of fermented liquors from grain. The crystals of diastase or amylase, as the starch ferment is called by chemists, were obtained from solutions of the pancreatic extract in a mixture of alcohol and water. The crystals show resemblances to proteins, those nitrogen-containing compounds which form so large a part of the stuff of the body.

This is the third digestive substance to be isolated. Protease, also found in digestive juice, which digests proteins like gelatin or the casein of milk, was recently crystallized by Dr. John H. Northrop and Dr. M. Kunitz at the Rockefeller Institute for Medical Research at Princeton, New Jersey. Urease, the enzyme that transforms

for plant

(Please turn to page 277)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS year there have been two conventions of amateur telescope makers—one held in July at "Stellafane" near Springfield, Vermont, as in the previous five years, and a new one held in August in Pittsburgh by the Astronomical Section of the Academy of Science and Art. We hope that next year there will be several others, covering the whole nation. The hobby of amateur telescope making continues to thrive and spread like a lusty culture of disease germs on an agar-agar plate. Our own fell, deep-dyed hope is to infect the entire planet.

About the usual number—some 125 amateur telescope builders—attended the annual powwow at "Stellafane," in spite of hard times.

This year the Porter turret telescope was ready for use and a number of the more enthusiastic, wakeful amateurs spent the night keeping it busy. This is the telescope which was mentioned in advance of completion, in the SCIENTIFIC AMERICAN book "Amateur Telescope Making," at the top of page 51 (second edition), except that the Cassegrainian part has not yet been added. Light from a star reaches the diagonal flat mirror closely attached to the revolving turret, is reflected outward to a 16-inch paraboloid at the end of the framework structure of tubing, and this paraboloid returns it as a cone which passes through a hole in the flat. The eyepiece is within the turret. This turret is made of concrete cast on to steel plates and revolves in right ascension on heavy rolls, being turned by means of a hand crank. The arrangement of the turret proper resembles that used on the well-known Hartness turret telescope. The slender object projecting at the right is a length of four-inch shafting which serves as a counterweight. The observer remains within the turret and is protected from the icy blasts of the cruel Vermont winters and from the persistent attentions of the Vermont mosquito. In the picture the square part of the structure is of wood, and the entire part at the left is of concrete, the two being anchored together by means of heavy bolts.

The second big feature of the "Stellafane" gathering was a six-inch telescope made by a lady. This received so much attention, and its maker, Mrs. Thomas Jenkins of Albany, so much praise, that there is no record of anything like it. As soon as the convention was over, the newspapers of Albany got wind of this unusual accomplishment and obtained an interview with Mrs. Jenkins, at which the photograph reproduced in these columns was also taken.

Courtesy Albany Times-Union
Mrs. Jenkins and "it"

Incidentally, this same photograph was passed by the Albany papers into the hands of the press photograph agencies and thus came to be published in newspapers all over the nation. It is only fair to state that Mrs. Jenkins should not be credited with the misinformation in the legend published by most newspapers with the picture, as this appears to have arisen phoenixlike from the imagination of the press photographer, which surpasseth understanding.

Mrs. Jenkins is the wife of Thomas A. Jenkins, a representative of the General Electric Company, and has studied mathematics and physics at the New York State College for Teachers. She, with some help from Mr. Jenkins, devoted 130 hours to the mirror part of the job. This is the third woman who has successfully completed a mirror as an amateur, the others being Mrs. Skinner, a draftswoman who was one of the members of the original "Telescope Makers of Springfield" and Mrs. Margaret Weisenberg of New York (SCIENTIFIC AMERICAN, October, 1929, page 354). Women seem to possess a real instinctive flair for any kind of rouge and mirror work and it is hoped that others will essay it.

Russell W. Porter, the father of the amateur art in America, told the assembly about progress and some of the plans at Pasadena, especially with regard to the 200-inch telescope. In the site investigation the choice has now been narrowed down to three candidates. The investigation will be continued while the work on the great telescope progresses, as it is only by integrating the findings of several years at a given site that a safe criterion of seeing can be obtained. One site, for example, which had performed splendidly for more than a year suddenly "blew up" and gave such bad seeing during a subsequent period that it was entirely thrown out of the running. One site is at Palomar about 100 miles south of Mount Wilson. A second candidate is about 100 miles east of Pasadena at an elevation of about 7000 feet, while a third is in the Mint Canyon near the Mojave Desert. Work on the 200-inch mirror is progressing, perhaps more slowly than the eager public wishes, but the intention is to avoid any haste that might later prove prejudicial to the main consideration, the telescope. The job will require a number of years at best, some of the newspapers and ill-informed writers to the contrary notwithstanding.

Photo by James Stokley
Porter's turret telescope at "Stellafane"

THE other assembly of amateur telescope makers was held at Pittsburgh, Saturday and Sunday, August 8 and 9 and, being well advertised in advance, brought more than 100 amateurs to that city, the visitors coming from eight states. Several professional astronomers attended the meeting. The interesting J. W. Fecker plant was visited. At the Allegheny Observatory a number of speeches were listened to, including those by C. B. Roe, President of the Pittsburgh club of amateurs; R. W. Porter and John M. Pierce of Springfield, Vermont; M. D. Blish, secretary of the newly organized club, "Amateur Telescope Makers of Chicago"; J. W. Fecker who has just completed the 69-inch mirror for the Perkins Obser-

vatory at Ohio Wesleyan University; and Dr. James Stokley, Director of the Fels Planetarium in Philadelphia. A wreath was placed on the tomb of "Uncle John" Brashear, the great mirror maker.

On Sunday a visit was made to the Valley View Observatory, which was described in the July 1931 SCIENTIFIC AMERICAN, pages 30-32. This is the headquarters of the Pittsburgh group. A ten-inch mirror was silvered as a demonstration. There were other activities and everybody had a good time. An informal account of this gathering, from a private communication by R. W. P., reads in more lively style. "Just back from Pittsburgh. Fine time. Those fellows did well. Headquarters in big hotel, badges, cars with big signs announcing convention. Fecker gave them the run of his shop. Supper, much speechifying. Evening at Allegheny Observatory, clear night. Hottest night ever. Sunday, spent morning with Fecker. Had a look at the 69-inch over a knife-edge. Wow! Everything at this meeting was done fine."

So there you are; amateur telescope making still lives.

HERE is something else, this time from Chicago, a letter from Gerald E. McCord, President of the "Amateur Telescope Makers of Chicago."

"The readers of this magazine may recall former statements that an organization for amateurs in telescopy and astronomy was being formed in Chicago. We are pleased to present the following report of our progress to dat

"In March of this year the first meeting of this group was held at the Hotel Sherman in Chicago for the purposes of organizing and planning a program. A constitution was drawn up and the name 'Amateur Telescope Makers of Chicago' was selected. The constitution reads in part: 'The purpose of this organization is to promote interest in astronomy among the amateurs of Chicago and to assist all members in the art of telescope making.'

"There are now 45 names on our rolls. Meetings are held the first Sunday evening of each month. They are a combination of business meeting and small group discussions of some question that is giving some member trouble at that time.

"Completed mirrors of the society number six and range in size from 3½-inch to 24-inch. The 24-inch telescope was built by Mr. F. W. Nack and is now in use. Five other mirrors are in process of construction, the largest of which is being ground from an especially made disk of Pyrex. Its diameter is 12 inches.

"We will welcome contact either in person or by correspondence, with other amateurs anywhere. Address all mail to the secretary, Mr. M. D. Blish, 7548 West 62nd Street, Argo, Illinois or phone Kildare 8971 and ask for Mr. W. L. Dennis, if you are in town. Our technical adviser and an honorary member of the society is Mr. J. E. Mellish."

THAT Jap, Nagata, has earned the right to carve his initials on the comet he recently discovered, the comet having been named for him as is the custom. Nagata is not a telescope maker but is an amateur astronomer nevertheless. Here is a star for the telescope maker to hitch his wagon to: let him discover a new comet—and fame.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

THE JENNINGS CENTRIFUGAL PUMP gives some valuable data for those interested in hydraulics. Particular attention is paid to position of suction and discharge connections. *Nash Engineering Company, South Norwalk, Conn.—Gratis.*

WHERE TO BUY SUPPLIES FOR EDUCATIONAL INSTITUTIONS is a pamphlet which is invaluable to educational authorities and purchasing agents of schools, colleges, and summer camps. *Porter Sargent, 11 Beacon St., Boston, Mass.—Gratis.*

AN ANEMOMETER FOR A STUDY OF WIND GUSTS (Engineering Research Bulletin No. 20 University of Michigan) by R. H. Sherlock and M. B. Stout describes a new type of pressure plate anemometer for research on the loading and strength of overhead power lines. The apparatus is fully illustrated and described. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—$1.00.*

OUTDOOR SPORTS LIGHTING illustrates some recent installations which allow longer playing hours. Every outdoor sport can now be played under artificial light. This pamphlet contains a remarkable series of diagrams showing how various courts and fields should be lighted. *Nela Park Engineering Dept., General Electric Company, Cleveland, Ohio.—Gratis.*

PARACHUTE SUPPLEMENT OF AIR COMMERCE REGULATIONS (Aeronautics Bulletin No. 7-D, Aeronautics Branch, U. S. Department of Commerce) deals with parachute approval and maintenance and parachute riggers. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

REPORT ON THE VEGETABLE OIL INDUSTRY OF HYDERABAD STATE (Bulletin No. 1, New Series, Commerce and Industries Department, the Nizam's Government) by A. F. Yuill gives information on the oil-seeds and oil-crushing industry in this part of India, but the information will prove of value to all interested in vegetable oils. *Nizam Jubilee Press, Hyderabad (Deccan), India, 3 rupees.—$1.10. Remit by International Money Order.*

CURRENT DEVELOPMENTS IN AMERICAN COLLEGE SPORT (Bulletin No. 26, The Carnegie Foundation for the Advancement of Teaching) by Howard J. Savage, John T. McGovern, and Harold W. Bentley deals with the relation of college and school athletics to the educational process and insists that the final responsibility rests with the university or college officers. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Ave., New York City.—Gratis.*

WATER FILTRATION FOR ALL PURPOSES (Bulletin No. 194) describes in great detail the filtration of water for water supply and swimming pools. The pamphlet is well illustrated. *Wm. B. Scaife & Sons Co., Oakmont, Pa.—Gratis.*

MOSS PEAT, ITS USES AND DISTRIBUTION IN THE UNITED STATES (Circular No. 167 U. S. Department of Agriculture) by A. P. Dachnowski-Stokes describes the imports, uses, requirements for a successful moss-peat industry and the distribution of moss-peat in the United States. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

WOOD-LIQUID RELATIONS (Technical Bulletin No. 248, U. S. Department of Agriculture) by L. F. Hawley gives the relations between wood and liquids. Substantially every important property of wood is affected by the presence of some liquid, in one form or another, so there are many important problems involved. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE MERRIMACK ARCHEOLOGICAL SURVEY by W. K. Moorhead is a 79-page illustrated account of the Indian archeology of the Merrimack River valley and is the work of a noted archeologist. *Andover Press, Andover, Mass.—$1.25.*

SANITARY DRINKING FACILITIES WITH SPECIAL REFERENCE TO DRINKING FOUNTAINS (Bulletin of the Women's Bureau, No. 87, U. S. Department of Labor) was prepared by Marie Correll of the Division of Research of the Women's Bureau. The pamphlet deals with the source of water, bubbling fountains, individual paper cups, and the location of drinking water facilities. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE RUINS AT KIATUTHLANNA, EASTERN ARIZONA (Bulletin of American Ethnology 100, Smithsonian Institution) by Frank H. H. Roberts, Jr., describes the effort to obtain additional data on certain phases of the earlier archeological horizons. The pamphlet has 195 pages and is profusely illustrated. *Superintendent of Documents, Washington, D. C.—65 cents (money order).*

THE DESIGN OF CAPACITOR MOTORS FOR BEST STARTING PERFORMANCE (Engineering Research Bulletin No. 19, Department of Engineering Research) by Benj. F. Bailey is a treatise in which the writer has endeavored to simplify the fundamental theory and the methods of making the necessary computations for the design of capacitor motors. *Director, Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—50 cents.*

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF CHEMISTS (*The Chemist*, Volume VIII., No. 9) describes the presentation of its medals to Messrs. Andrew W. and Richard B. Mellon for their notable achievements, particularly the founding of the Mellon Institute, which will soon occupy its magnificent new building. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

RESEARCH ON FUEL ECONOMY AT MELLON INSTITUTE (Reprint from *Combustion*, Oct. 1930) by William A. Hamor tells of the work the Mellon Institute is doing in the fields of fuel economy. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

X-RAY PROTECTION (Handbook, Bureau of Standards No. 15) gives a unified set of safety recommendations and was prepared under the direction of an eminent committee. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

MEDICAL EXAMINERS OF THE AERONAUTICS BRANCH (Aeronautics Bulletin No. 23) gives a list of medical examiners in all parts of the United States, numbering 800 in all. The result of their examinations is reported to the central office in Washington where qualification or disqualification is made. The scale of fees is given and varies from 5 dollars to 15 dollars. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

STUDY OF INLAND WATER SITUATION by Samuel S. Weyer presents in very graphic form man's dependence on water. The facts are admirably presented. Those who wish the salient facts in relation to the Mississippi River drainage flood problem will get them here. *Fuel-Power Transportation, Educational Foundation, 1116 Beggs Bldg., Columbus, Ohio.—Gratis.*

SIXTEENTH ANNUAL REPORT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, 1930 (including Technical Reports Nos. 337 to 364) is a large quarto volume of 787 pages, fully illustrated and bound in buckram. It is one of the most valuable contributions ever made to aeronautical literature. It is, of course, published at cost as it is not the policy of the Government to make a profit on its technical literature. *Superintendent of Documents, Washington, D. C.—$1.50 (money order).*

YEAR BOOK OF THE DEPARTMENT OF AGRICULTURE 1931 (House Document No. 777, 71st Congress, 3rd Session) is the usual handsome volume dealing with the year in agriculture—what is new in agriculture, department publications, crop and livestock production trends, and 507 pages of statistics. The first half of this cloth-bound book is well illustrated. *Superintendent of Documents, Washington, D. C.—$1.50 (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 273)

use, was first made crystalline in 1926 by Dr. James B. Sumner at the Cornell Medical College.

The enzymes or ferments play a very important part in the life processes of plants or animals. They accelerate chemical reactions without themselves being used up in the process. Chemists call such substances in general catalysts, but enzymes are very special kinds of catalysts which are extremely unstable and therefore difficult to handle in the laboratory.—*Science Service.*

Soap vs. Germs

SOAP, and common soap at that, has been found to have remarkable germ killing powers, by John E. Walker, M.D., of Opelika, Alabama, who has reported his findings to the American Medical Association in the *Journal* of that organization of physicians.

While it is unsafe to generalize too freely about the germ killing power of soap since some germs are affected in a way quite different from others, Dr. Walker finds that soapsuds "compare favorably with many of the recently synthesized chemicals that have been heralded, at least in advertisements, as crowning achievements of modern chemistry." He says that the recognition of the germicidal properties of soap is comparatively recent, and the standard textbooks on surgery and bacteriology make practically no mention of these properties.

There are, however, two germs against which the thorough washing of hands with soap is not effective: those of typhoid fever and the staphylococcus organism. On the other hand, the thorough washing of the hands with soap suffices for the destruction of streptococci, pneumococci, meningococci, gonococci, and diphtheria bacilli; also influenza bacilli.

Where it came to kinds of soap, Dr. Walker found no very wide differences between them. There actually was a difference of a few fold in germ-killing power, though this difference varied with the kind of germs. In any case, such differences would make little difference, so to speak, because it was found that the ordinary lather one makes in washing the hands is many times as concentrated as the concentration of soap found necessary to kill germs even with the weakest soaps. White floating soaps, perfumed toilet soaps, laundry soaps, cocoanut-oil and olive-oil soaps—all came out of the test in good standing though, of course, none was as germicidal as carbolic-acid soap.—*A. G. I.*

Chemistry to Establish Value of Farm Crops

DECLARING that farm products are worth only as much as the chemical value of their components, William J. Hale, in a recent address to the Manufacturing Chemists' Association attributed the world-wide economic depression to the organic chemical revolution. [Although Mr. Hale's

ideas do not coincide with those of the editor, we present them for what general interest they contain.]

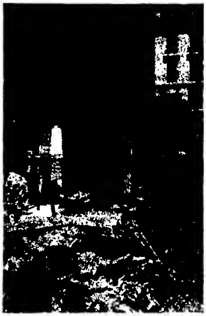
"Those Industrialists and politicians who cry aloud for higher prices on agricultural staples in order that the money paid to the farmers will find outlet in greater purchasing power for industrial products are only crying for their own destruction," he said. "Chemistry decrees that these organic chemical mixtures—staples, if you wish—never again can sell for more than the sum of the chemical values of their several components, and simply because these components are obtainable elsewhere with less expenditure of labor. Thus, cotton, of 99 percent alpha cellulose content, is of little more value than the alpha cellulose of 98 percent purity, obtainable now from wood at a price of six to seven cents per pound. Cotton, therefore, must compete with this alpha cellulose, and unless it can be sold for approximately 10 cents per pound or less, it will sooner or later pass entirely out of domestic consumption. Corn, wheat, and other staples must follow in line. Corn at 40 cents per bushel and wheat at 60 cents per bushel carry a value about the equivalent of the sum of the values of the chemical components contained in these grains, and never again should sell at higher prices.

"It is reported that we are in a period of depression, but how can we consider prices depressed when they approach the actual values of the products concerned. Thus, crude oil at the wells is not worth over 50 cents a barrel, nor is coal at the mines worth more than two dollars a ton, and yet there are those who would have us believe that petroleum must be conserved, that it is a great asset to the country, and that its passing might mean our undoing.

"To all this, the chemists's reply is: 'Tommyrot!' We don't need this oil; use it as best we can at as low a price as possible. When it is gone, we shall use up the coal, also at as low a price as possible. When the coal is gone, we shall manufacture hydrocarbons at lowest prices, and our children will relate stories of how their fathers wasted their time digging holes in the ground to get out a lot of dirty fossil remains at a tremendous cost of time and labor. There is nothing so childish as this cry of conservation when the chemist eady knows how to provide the requirements in heat, power, and light for the ce without any coal or oil in e picture any clai and other staples are now selling below the cost of their production. Undoubtedly this is correct for certain sections of the country, but for other sections it is most decidedly not. Whenever a high cost of production prevails, the agriculturists must cease this particular pursuit. What we want are low-priced basic commodities, and these we will have."—*A. E. B.*

Artificial Sponges from Cellulose

AN artificial sponge is being manufactured in Germany under the name "Agfa-Viscose-Sponge." It consists of regenerated cellulose, and is similar to the artificial silk manufactured from viscose. It combines the advantages of the natural sponge without its disadvantages, and can be boiled with soap or soda without losing its shape or stability. It can be made in every desired size with large or small pores. In contrast with the sea sponge, the new sponge has smooth, plain surfaces of outstanding absorptivity. It is suitable, not only for body care, but also for all types of cleansing, especially for washing automobiles, wagons, boats, and the like. —*A. E. B.*



Instead of using the usual ramps for trucks hauling debris from an excavation job, one New York contracting concern has installed elevators to speed up transportation

Spontaneous Combustion of Hay

"FROM the time it is cut until it is used, fully one tenth of the harvested hay crop of the United States is lost as a result of spontaneous heating; it is as surely lost and consumed as if American farmers had consigned every tenth load of their harvest to the flames," said Dr. C. A. Browne, of the Department of Agriculture, recently in making public the results of the latest investigations of the spontaneous combus- of hay.

Doctor Browne said that although the annual loss resulting from the burning barns and other farm property United States as a result of spontaneous combustion has been estimated to exceed 20 million dollars a year, the actual loss in the decrease in the weight of nutritive value of hay during spontaneous heating will annually amount to many times that sum.

"The spontaneous heating of hay," says Doctor Browne, "takes place in three stages. The first stage is due to the vital activity of the living cells of the grass which continues for some time after it is cut. As a ult of these cellular processes, the sugars and other carbohydrates of the grass begin to break down and heat is evolved. If the freshly cut grass is placed in a pile, the escape of heat is retarded. The heat can be felt by inserting the hand into the pile.

"When the mass of heating hay reaches a temperature of 110 degrees, Fahrenheit, the life of the grass cells is destroyed, and then commences the second period of spontaneous heating caused by the molds and

bacteria that occur naturally in hay. The numbers of the micro-organisms, because of the favoring warmth and moisture produced in the first stage of heating, increase greatly and additional heat is produced, the temperature rising as high as 180 or 185 degrees, Fahrenheit.

"When hay is properly cured by the ordinary process, its moisture content is reduced from about 75 percent to less than 20 percent, at which point the vital processes of the cells stop and bacteria and molds can not live, so there is then very little danger of the hay overheating in the stack or mow. The vital processes of the grass cells in improperly cured hay have not been completely arrested and heating begins in the interior of the mow; moisture is driven from the warmer to the cooler parts; and the hay begins to 'sweat.'"

To prevent fire resulting from the heating hay, Doctor Browne advises that if a burnt odor becomes perceptible measures should be taken to locate the fire pocket which has formed somewhere within the mow. This can be done, he says, by boring into the 'ent places with a steel tube h a sharp cutting edge. If a section of the tube is very hot when it is removed and the core of hay in it appears burned, this indicates a fire pocket. In case of a fire pocket, the hay must be removed at once, but first provide fire extinguishing appliances or water for extinguishing any outbreak of flames, for there is always danger that the sudden admission of air to the fire pocket may cause the outbreak of flames.

Light with Less Heat

ELIMINATION of three fourths of the heat, with negligible loss of light, has been accomplished in a new type of high-intensity incandescent lamp equipment developed in the Research Laboratory of the General Electric Company.

Little heat escapes from the powerful light surrounded by a liquid

There are numerous applications where intense illumination with a minimum amount of heat is required, such as over operating tables in hospitals, in lighting wax models and other objects in store window displays, and in opaque projection.

Heat is a necessary evil with all man-produced light; the scientist cannot produce the cold light of the firefly, and such light is not the type generally wanted, anyway. Approximately 85 percent of the electric energy consumed in the most efficient tungsten incandescent lamp is radiated as heat, although in the household-size units this heat is not objectionable. When larger lamps are used, however, the heat quickly becomes apparent.

The elimination of the heat is accomplished by absorbing the heat rays in a liquid surrounding the bulb. Distilled water, a solution of copper chloride, and some other solutions will absorb heat while transmitting most of the light. The heat is conveyed away from this solution by means of a cooling coil through which water is circulated.

The new unit consists of a lamp immersed directly in the absorbing liquid, which is confined by an outer glass jacket. The cooling coil through which tap-water is circulated is also immersed in this liquid. Convection currents set up within the jacket liquid are sufficient to maintain a circulation, and no mechanical stirring is required.

In cases where a tap-water supply is not available, a radiator, such as is used with automobiles, may be used with a closed water system. A pump is then used to circulate the water, and a fan to cool the water in the radiator, which may be placed at a distance.

The absorbing layer of liquid practically surrounds the light source, so that almost no radiation reaches the atmosphere of the room except through the absorbing medium. The cooling water is circulated in and confined by the coil, so that either distilled water or some heat-absorbing solution may be kept permanently in the jacket. The jacket and lamp surfaces are thus kept clean and free from the deposits of ordinary tap-water, even though this is the cooling agent.

Maternity

THE United States has a higher death rate from childbirth than any of the 20 other countries from which statistics are available, according to Dr. Howard W. Haggard, associate professor of physiology at Yale University. Dr. Haggard's comments were broadcast as part of a series of talks entitled "Devils, Drugs, and Doctors."

Available childbirth mortality figures, he pointed out, range from 2.6 per thousand to 6.6. Denmark and Italy lead the world with the lowest figure. The United States stands at the bottom of the list. "These figures for our country, translated into actual deaths, mean that each year in the United States 16,000 mothers die leaving behind them their new-born babies," Dr. Haggard said. "As compared with Denmark and Italy, 10,000 of these mothers die unnecessarily. The means exist to prevent these deaths, but the fact that the deaths continue year in and year out signifies that the means are not made available to the mothers who need them."

The Maternity Center Association supplies complete education and medical care to mothers requesting it in one area of New York City. The maternity death rate among women receiving this free service is 2.2 per thousand, the lowest recorded in the world, compared with 6.2 mothers in the same district who do not come

under the care of the association. Dr. Haggard cited these statistics to bear out his point that the high national mortality rate is unnecessary.

"In our country," he said, "we have physicians specializing in obstetrics who are as skilled as any to be found elsewhere in the world. Our nurses are as well trained as those of any other country. We have many excellent maternity hospitals. But these means of saving lives and insuring health are not available to most of the mothers of this country."

"Battledeck" Floor in Garage

AN automatic arc welding machine, crawling along by its own power, has demonstrated its value in the construction of a new type of steel floor for buildings. The Wendell Garage, owned by the Berkshire Auto Company in Pittsfield, Massachusetts, is the first to use this machine on what is known as the "battledeck type of floor construction". It was used at a considerable saving in cost in the erection of a two-story addition to the garage.

The American Institute of Steel Construction is the sponsor for the new kind of flooring. It was first announced at a convention of that body in Biloxi, Mississippi, November 14, 1929, and described in SCIENTIFIC AMERICAN. Proponents of the method showed the new flooring involves much less weight than other types and is able to stand every kind of service.

Justification for these claims was found in the Pittsfield application. Unusual construction problems confronted the owners, and these were entirely solved through the use of the welded floor, and its advantages over the conventional concrete slab floor were demonstrated. The architect, George E. Haynes, found it necessary to erect a two-story addition in the angle of a one-story building with a ramp leading from the ground floor of the existing building to the second floor of the new structure. The space available for the ramp was of limited length and, as it was essential that the practical rise should not be exceeded, these facts determined the height of the second floor. It was required that the first floor be without columns. As the depth of the second floor construction determined the ceiling height of the first floor, it was obvious that the ordinary concrete slab method of floor construction would have made the height in the clear less than that required by the owner. The span had to be cleared across the 60 foot width and the girders not less than 20 feet on centers.

Computations showed requirements of a 6-inch concrete slab and a 36-inch girder, making a total of 42 inches from the top of the second floor to the under side of the girder. This was more than could be used. The weight of the concrete was 75 pounds per square foot and the girder was 300 pounds to the foot, in addition to the other steel.

The battledeck floor was investigated and it was immediately apparent that the height of the girder plus the thickness of the plate would be the total thickness of the floor. This showed a 33-inch, 200-pound girder representing a saving of 80 pounds per square foot on girders and of 9 inches in the depth of the floor.

The battledeck floor consists of 5-inch, 10-pound I-beams, spaced 24 inches on centers with ¼-inch steel plates placed from the center line of one I-beam to the center line of the adjoining I-beam and from center to center of girders. An allowance of ¼ inch between plates was made. The battledeck construction weighs 15 pounds per square foot as contrasted with 75 pounds per square foot of concrete slab construction. This startling decrease in dead load was surprising to construction men. It resulted in reduced column requirements and footings. The footings were very important as, in order to avoid cantilever, the footings extended under the existing walls at the column point.

There was used a total of 193 separate ¼-inch steel plates each 2 feet wide, making a total area of 40 by 160 feet, or 6400 square feet.

Ship Stresses

EVERY ship is, on the whole, a thin-skinned, supported beam which is subjected to various stresses by the sea's movement and by the weight applied when being loaded. Designers' calculations of the extent of these stresses can not, by present formulas and knowledge at least, be calculated with the exactitude of those on a stationary land structure such as, for example, a bridge.

In order to throw new light on this problem in ship-building, Dr. W. Dahlmann of the Technical College and Engineer Paul Maack of the Government School for Ship Engineers, both in Hamburg, Germany, some time ago made a series of stress measurements on the S.S. *Hamburg* of the Hamburg-American Line. These measurements were made by fixing extremely sensitive and exact instruments on the ship's walls and on its interior sup-

Courtesy General Electric Company

An electric-arc welded "battledeck" floor in place

parts to measure even the smallest stresses and strains of the structure.

While a report of the results obtained has not been given out, it is expected that they will supply data on the "creeping" of various parts of the ship under the influence of twisting and turning movements of the sea and under the influence of loading operations. From these data may then be concluded the strength of materials necessary to neutralize or eliminate the "creeping" movement which, no doubt, will cause changes to be made in shipbuilding design.

Making a strain measurement in determining the stresses on a ship

Honey High in Food Value

HONEY is one of the best of the high energy-producing foods, says the United States Department of Agriculture. Because it is composed almost entirely of simple sugars it can be assimilated with ease. Most sugars require action by the gastric and intestinal secretions to break them down into simple sugars similar to those occurring naturally in honey.

Because it is easily assimilated, honey is of importance where normal digestive activities have been impaired by disease or old age. Honey can be utilized by the body without placing much of a burden on an enfeebled digestive tract and is also recognized as a valuable food for babies and young children.

Honey is especially good in the diet of athletes. The rapid absorption of the simple sugars of honey replaces the sugars in the blood and muscles that have been burned by strenuous exercise.

Odors Add to Sales Appeal

PLEASANT odors, many of them artificially compounded in the chemical laboratory, are being used to make various articles of merchandise more appealing to the customer. A silk hosiery manufacturer, for instance, uses scented lubricating oils in spinning its thread, and the stockings have a nice odor, says James H. Collins of Arthur R. Maas Chemical Laboratories.

A soap manufacturer makes laundry soap that leaves clothes with a clean fragrance—lavender, we believe.

This is no limited feminine appeal. An overall manufacturer kills the smell of new cloth and dyestuffs by giving his work-clothes a distinct perfume of masculine type. Just as there are heavy scents preferred by brunettes, and light perfumes suitable for blondes, so there are men's scents, among which are lemon and mignonette.

How does peat smoke strike you for a man's perfume? Scotch tweed cloth has long been known to buyers by the peat odor of the weavers' cottages. There is no reason why peat, or piney woods, or similar scents should not be imparted to goods for men.—*A. E. B.*

Pi

A MNEMONIC is a simple device for aiding one to remember something easily forgotten. For example, we meet a Mr. Fish and, wanting to remember his name, we couple his mental image with that of a fish. (And the chances are that the next time we see him we call him "Mr. Perch." Mnemonics are convenient—if we can manage to remember the mnemonic itself.)

A fine mnemonic for remembering the series of capital letters, OBAFGKMRN, which designates the well-known Draper sequence of star types, is "O, be a fine girl; kiss me right now." This mnemonic is regularly taught by serious professors of astronomy, who find it a sure way to make their students remember the letters and their proper sequence.

Sir James Jeans has worked out a neat mnemonic for remembering *pi* (π) to 10 decimal places, pi being 3.1416 to most of us and 3.14159265356+ to those of us who like to remember such things. He gives "How I want a drink, alcoholic of course, after the heavy chapters involving quantum mechanics." If we write down in a series the numbers of letters in the respective words of this sentence we get *pi* as given above.

One of our readers, Alan S. Hawksworth of Washington, D. C., has devised a mnemonic for remembering the value of $\log_{10}\pi$ to 15 decimal places. The sentence runs: "This logarithm employs a zero character, mantissa follows, in digits precisely what I now give."

The Draper classification mnemonic and *pi* mnemonic given above might be characterized as "motivated." We get—or at least we ask for—respectively, a kiss and a drink. What seems most needed now is a suitable motivation for the mnemonic for $\log_{10}\pi$. Perhaps some of the readers can improve on it.—*A. G. I.*

Bran

THE perennial controversy about bran runs on and on, some condemning it, others praising it. (See page 188, September 1931, SCIENTIFIC AMERICAN.) In the *Journal of the American Medical Association* Dr. Murray B. Davis of Nashville cites a case in which a patient who had suffered for years from constipation and been an addict to the "pill" habit switched to bran. A week later sudden illness enforced an operation and a mass of bran the size of a hen's egg was found completely obstructing the bowel.

Dr. Davis comments that the public has come to believe that bran is harmless, but that Dr. Alvarez, the famous stomach specialist, regards it as one of the most indigestible foods to be found in nature. In fact bran, the covering of the wheat kernel, has been especially adapted by nature to

protect the seed in its passage through the intestinal tract of herbivorous animals. It is his belief that those who have perfect digestions may be helped by roughage, but those who have irritable bowels may get into trouble. The bran may ball up in the small intestine, especially in the case of persons with sluggish intestinal tracts—those whose bowels move normally only once or twice a week.—*A. G. I.*

Pre-cast Sewer Pipe Joints

SEWER joints of asphaltic rings precast in the bell and on the spigot of the pipe recently were used with marked success in Seattle for an intercepting sewer where extreme groundwater conditions in clay and quicksand formation on a pumping line made effective joints of extreme importance. Previous trouble experienced by the city with root growths, combined with numerous sewer failures caused by leaky joints, with subsequent washout and collapse, prompted the test of the asphaltic joint in place of the cement-mortar type. The new joint is similar in some respects to the Stanford coal-tar joint used in Europe, but it has been improved as to jointing material, the method of application to the pipe and the resulting characteristics of the joint.

Manufacture of these joints under plant conditions by skilled workmen is in decided contrast to the problem of producing good joints under field conditions. The process consists of casting asphaltic rings to form the joint on the bell and spigot of each pipe section. The material is about 60 percent inert matter that is ground from pipe fragments and 40 percent asphalt. The resulting compound is flexible at freezing temperature, softens at 212 degrees, Fahrenheit, and flows at 300 degrees; the penetration is from six to eight at 77 degrees. These characteristics are for a standard mix and may be modified to provide for different requirements.

The scarified bell and spigot of the pipe length are painted with a solvent about one hour before applying the hot asphalt, assuring proper adhesion to the pipe, which is essential to the success of the joint. Machine-made molds for both halves of the joint are provided with a slight taper. Molds for the spigot end are placed on a leveled pouring platform, and the ends of the pipe are centered in them by eye. The molds for the bell end are placed and the rings poured with the asphalt at a 400-degree temperature, as shown in the accompanying illustration. Prior to pouring, the molds are whitewashed to prevent sticking and provide a coating on the joints to make handling easier. Following pouring, the molds are allowed to remain in place until the compound has cooled and shrinkage completed.

Simplified laying procedure under adverse conditions is a particular advantage in the use of this joint. Just before they are lowered into the trench, the collars on both ends are swabbed with a solvent that livens the surface of the asphalt. The pipe lengths are lowered into the trench by ordinary methods, placed in position and "shoved home" to complete the simple laying procedure. For sizes under 21 inches a properly anchored bar provides sufficient leverage to close the tapered joint. An ordinary hand-jack with a trench brace is used for 21-inch pipes or larger. Within an hour after the joint is laid, tests have proved that it becomes a homogeneous mass even when laid under water.

This property of consolidation is of particular importance as it permits construction practices which materially reduce costs and assure a tight joint under extremely adverse conditions. Before placing a length, the workman merely removes by hand any pebbles or large material from the bell of the previous pipe, and any sand or silt that remains is consolidated in the joint itself. Tests have indicated a successful joint after the pipes have been sub-

Hot asphalt being poured in making efficient pre-cast sewer pipe joints

jected to a freezing temperature for 48 hours prior to jointing. Other tests have shown no sign of leakage at the joint with pressures of 70 pounds per square inch, although this test did not indicate its ultimate strength.

Development of this joint was made under the direction of J. C. Johnston, northern division sales manager of Gladding, McBean and Company, manufacturers of the pipe for the project. He was assisted by H. E. Faulkner, engineer of tests, Seattle, together with W. E. Lemley and Howard Manser of his own company.

Process To Use Domestic Manganese Ores

THE Bureau of Mines has developed a practical method of solving the emergency manganese problem, which is of exceptional importance to the steel industry should a war or some other cause cut off foreign supplies of high-grade manganese ore, according to information made available at the Department of Commerce.

Manganese, it was explained, comprises 80 per cent of the alloy, ferromanganese, as used in making steel, and there is a scarcity of ore in this country of sufficiently high grade for ferromanganese production. Intensive work by the Bureau on the deoxidation of steel with manganese-silicon alloys, which can be made from domestic manganese ores, has shown their use would decrease ferromanganese requirements of

our steel 60 to 80 and even 100 percent. Excellent quality steel has been made with these alloys, it was stated.

The following additional information was furnished at the Department:

Manganese is used in the steel industry to improve blast furnace operation and to make the steel workable by offsetting the harmful effects of oxygen and sulfur. Another reason for the use of manganese is that high manganese steels have been developed with great success recently. The manganese gives to the steel many desirable physical properties.

Processes have been developed for utilizing domestic manganese ores which should easily fill our reduced ferromanganese requirements brought about by the use of manganese silicon alloys. There are no technical difficulties in the application of the practice of using these alloys and any difficulties involved would be only those arising from habituated ideas of the necessity for ferromanganese.

General acceptance of this practice and development of the available sources of domestic material suitable for making ferromanganese should make this country independent of foreign ores.

When our country was shut off from outside sources of manganese ore during the World War, the price of ferromanganese ranged from 100 dollars to 400 dollars per ton and there was grave concern as to the availability of manganese at any price. The lack of domestic ores of ferromanganese grade was keenly felt during that period.

During the last decade there has been a continuous effort to develop a domestic manganese industry in this country and some advance has been made. This gain however has not been striking enough to give the steel manufacturer any great amount of confidence that he can rely on domestic ferromanganese of the regular 80 percent grade during an emergency.

Imports of manganese ore depend not only on the relations between our nation and others but also on social and economic conditions within those countries which supply us. Ores of a composition permitting the manufacture of ferromanganese at a reasonable price are plentiful in Russia, India, Brazil, and the African gold coast.

The most important finding of the Bureau in investigating the use of manganese silicon alloys for the deoxidation of steel was that a ferro alloy containing manganese and silicon in the ratio of 5 to 1 was the most efficient in making clean steel at a decided saving in cost to the steel manufacturer. The reduction in ferromanganese requirements is striking. Further tests have shown that in the grades of steel which constitute our largest tonnage, ferromanganese can be dispensed with by the substitution of ordinary spiegel and a product of excellent quality obtained.

Spiegel ordinarily contains 20 percent manganese, 5 percent carbon, 1 percent silicon, and 74 percent iron. There is a huge tonnage of low grade manganese ore in the United States suitable for the production of spiegel. In addition to these ores, there is a large tonnage of slag from open hearth steel furnaces which should be considered a potential source of manganese.

A SOLAR OBSERVATORY FOR THE AMATEUR

(Continued from page 257)

in the piston, which can be varied in size to vary the rate of flow. This rough contrivance served to give the photograph reproduced in Figure 8. A more perfectly made arrangement of the same kind would give smoother motion.

With the apparatus described above a great variety of experiments can be made. When clamped in a fixed position it serves very well as a spectroscope with which much of the visible ultraviolet and infra red spectrum can be photographed on plates sensitive to these regions. Many of the experiments described in books on spectroscopy can be easily performed as it is a simple matter to make the auxiliary apparatus required for producing the spectra of flames, arcs and sparks, while vacuum tubes containing hydrogen, helium and other gases are not expensive. The solar spectrum as already stated can be photographed and the presence in the sun of sodium, magnesium, calcium, iron and many other elements proved by photographing their spectra on the same plate beside it. By holding the sun's image exactly tangent to the slit during an exposure the bright lines of calcium, hydrogen and helium can be photographed in the chromosphere which surrounds the sun as a sea of glowing gas. These lines reach to higher levels in the prominences, the forms of which may be registered by using the instrument as a spectroheliograph and giving an exposure with the *K* line set on the second slit longer than that required for the sun's disk. In work of this kind the clock must keep the sun perfectly stationary and the direct light of the brilliant disk should be excluded by a circular metallic screen slightly larger than the solar image, fixed in position before the first slit.

It is easier to record the bright *H* and *K* lines in the spectra of the flocculi which are scattered irregularly over the sun as shown by Figure 8. For this purpose the instrument is fixed in position while the spectra of various parts of the disk (especially near sun spots) are photographed with exposures shorter than those needed for the prominences. Narrow bright lines will be seen on the photographs with a magnifier at the center of the broad dark *H* and *K* lines, at points where the first slit happens to cross calcium flocculi. The occasional eruptions on the sun's disk described in the articles referred to on page 244 are represented by exceptionally bright calcium flocculi which appear suddenly, change rapidly in form and area and last from a few minutes to two or three hours.

The advantage of using calcium light is most easily recognized by taking a photograph of the sun with the same instrument after moving the first slit a short distance so as to bring a part of the spectrum outside of the *K* line upon the second slit. In this case the calcium flocculi will not be recorded and only the sun spots, perhaps with some faculae near the edges of the disk, will appear.[1]

[1] Readers who wish to know more about the calcium flocculi may consult such books as Abbot's "The Sun" or Russell, Dugan and Stewart's "Astronomy."

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Patent Law in U.S.S.R.

A NEW statute on inventions and technical improvements, ratified by the government, came into force in the Soviet Union on May 25, 1931, states the *Economic Review of the Soviet Union.* All matters concerning the issue of patents and certificates of authorship are under the control of the Committee on Inventions of the Council of Labor and Defense of the U.S.S.R.

Two fundamental conditions which should be noted and which may be of interest to foreign applicants are as follows: (1) Foreigners have the same rights as citizens of the U.S.S.R.; and (2) as was provided under the previous patent law, persons living abroad must authorize a permanent resident in the U.S.S.R. to represent them in conducting their patent affairs.

Patents are issued only for new inventions which may have a practical use in industry. They are also issued for new methods of preparing medical, food, and flavoring substances, and other substances obtained by chemical means, but not for the substances themselves.

The procedure for dealing with an application for a patent is as follows: each application is subject to examination, in order to determine whether the invention is a new one. An invention is not considered to be new if prior to the filing of the application it was in use within the U.S.S.R. or abroad, or was described in a publication or made public in any other way so that the invention has become available to persons interested.

In granting a patent the following regulations apply: (1) Patents granted are valid for a period of 15 years. This period dates from final decision on the granting of the patent, but the rights of the owner are protected from the day on which the priority of his application was recognized. (2) Without the consent of the owner of the patent no one may make use of the invention. The owner of the patent himself may work his invention if he observes the laws regarding activity in private undertakings; particularly foreigners and foreign juridical persons may work their inventions if they observe the law regarding the arrangements for allowing foreign capital to engage in business within the U.S.S.R. (3) The owner of the patent may issue to another person permission to work his patent wholly or in part.

As regards the obligations of the owner of the patent, they include: The annual payment of the fees fixed by law. Further, he must work his invention on an industrial scale within the U.S.S.R. within three years from the day when the patent was granted, personally or through a licensee. If within the stipulated period the invention has not been worked, interested persons and organizations may petition the Committee to issue a compulsory license for use of the invention. In such a case the owner of the patent gets a remuneration, the amonnt of which is set by the Committee.

> MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
> —*The Editor.*

The law provides for another case in which the question of the compulsory issuance of a license may arise. This is when the invention is of essential importance to the government and no agreement with the owner of the patent has been reached. Then the owner receives a remuneration fixed by the Committee.

(*The verbatim text of the new patent law will appear in English in No. 6 of the scientific magazine on inventions, "Erfindungswesen," published in Moscow in the German language. This periodical may be procured from the Amkniga Corporation, 19 West 27th Street, New York City.*)

Correction

DUE to an unfortunate typographical error, the name of Edwin J. Prindle, well known attorney and author of the proposal for a single court of patent appeals, published in our September issue, was mis-spelled. We offer our apologies.

Color Not a Trademark

IN *ex parte* Boston Wire Stitcher Company, First Assistant Commissioner Kinnan held that the company, of East Greenwich, Rhode Island, is not entitled to register, under the Act of 1905, a trademark for staples for tacking, stitching, and binding in stick form, a mark described as "a yellow or gold colored lining on the inside of the staple stick or refill."

The ground of the decision is that the alleged mark constitutes merely a color unassociated with any design or symbol and not functioning as a trademark.

In his decision, after relerring to applicant's argument as to the difficnlty of applying an identifying mark to the goods themselves, and applicant's explanation of the manner in which its goods and the machines in which they are used are sold and the fact that other parties sell staples which do not fit applicant's machines causing them to operate unsatisfactorily and it was applicant's desire to have some identifying mark upon the staples, the First Assistant Commissioner said:

"It must be deemed settled law that an applicant cannot monopolize a color for its goods unless the color is in some design, symbol, or configuration as indicated by the Supreme Court in the case relied upon by the examiner. (Citing decisions.)

"It is not thought there is any case which supports the view that coloring the entire inside surface of a stick or refill in the manner disclosed by the applicant can be deemed as a trademark. It would seem this coloring of the entire inner surface cannot by any logical interpretation be regarded as a design or symbol."

Yarn-Dyeing Machine Maker Signs Stipulation

UNFAIR competition in the leasing of machinery will be discontinued by a corporation manufacturer of machines used for the random dyeing of yarns, according to a stipulation agreement between the company and the Federal Trade Commission.

Leasing its machines to manufacturers and sellers of woollen, cotton, and rayon underwear, in competition with other corporations and firms, the respondent agreed to stop attempting to enforce leases of its machinery on the conditions that the lessee shall not use or deal in the goods or machinery of competitors of the lessor. The conditions of this agreement apply in all cases where the effect of such lease may be substantially to lessen competition or tend to create a monopoly in commerce.

The corporation further agreed to cancel all restrictive clauses which may at this time be contained in leases now in effect, and to notify the lessees that such clauses are without effect.

"Electric" Radio Set Patent Upheld

THE invention covered by the Lowell and Dunmore "plug in" radio receiving set patent used on all alternating current operated sets has been held by the Board of Appeals of the Patent Office to be entitled to priority over competitive claims of four other individuals.

The Board sustained the findings, in 1929, of the Examiner of Interferences of the Patent Office, who held the Lowell and Dunmore invention was prior to the other inventions. The two engineers, at the time the patent was issued in 1923, were employed at the United States Bureau of Standards, and devised the patent during their studies in connection with aeronautical radio.

The following additional information was made available in connection with the case:

In 1929 the Federal District Court at Wilmington, Del., held that the Lowell and Dunmore patent was valid and infringed by the Radio Corporation of America. An appeal from that decision, however, now is pending before the Circuit Court of Appeals at Philadelphia.

The Department of Justice in 1929 instituted a suit against the inventors, claiming that the patent was properly the property of the United States, on the ground that it was devised and developed while the engineers were employes of the Bureau of Standards, with the aid of Government

materials and during Government time. The inventors, however, again were sustained in their contention that the patent was properly their property.

In the patent interference case before the Board of Appeals the four other participants were Prof. Michael I. Pupin, of the Westinghouse Electric and Manufacturing Co.; Albert S. Blatterman, of the Murad Radio Laboratory, Asbury Park, N. J.; Robert L. Duncan, of Wired Radio, Inc., of New Jersey; and Marius Latour, of Paris.

Use of Word "Mahogany"

THE Federal Trade Commission recently announced its dismissal of a complaint charging Gillespie Furniture Company, Los Angeles, with unfair methods of competition involving use of the words "mahogany," "Philippine mahogany" and other terms of which the word mahogany is a part, to describe furniture said to be made of woods other than mahogany.

Chairman Hunt dissented to the action of the Commission in dismissing the complaint. Commissioner McCulloch also dissented and filed a memorandum of dissent, which follows:

"Respondent, Gillespie Furniture Company, deals in furniture made of wood grown in the Philippine Islands, and in selling respondent represents it as made of 'Philippine Mahogany.' This is charged to be a false and misleading representation —that the wood is not mahogany.

"True mahogany is a wood of the botanical species Swietenia, of the tree family Meliaceæ. Furniture made out of it has, for time out of mind, been held in high esteem.

"The wood now under consideration has never been known in the Philippine Islands as mahogany—it is called 'lauan' and 'tanguile,' and is not of the tree family 'Meliaceæ.' It belongs to a family entirely different from mahogany, and it is first called mahogany after it has been received here and put on the market by lumber dealers. In other words, it is not, botanically speaking, mahogany, though it has some of the same characteristics. This much is shown by uncontradicted testimony. According to what the writer considers the preponderance of the evidence, this wood is quite inferior to true mahogany for use in making furniture and other things, and does not come up to the commercial test of mahogany. When highly finished it has the appearance of mahogany, and its designation as mahogany is deceptive to the purchasing public.

"Several years ago the Commission issued complaints against six separate respondents upon the charge of falsely representing the Philippine wood 'lauan' or 'tanguile' to be mahogany, and on trial of the cases orders were issued requiring each of the respondents to desist. The cases were reviewed by a Circuit Court of Appeals, on application of a respondent, and the orders of the Commission were affirmed. The Supreme Court denied the respondent's application for review on certiorari.

"The court decided that the botanical test was controlling, and in disposing of that question said:

"'It becomes unnecessary for us to discuss here the difference of expert opinion as to whether the trade designation mahogany should be confined to one or more species of the genus Swietenia, for wood from trees which in no way belong to either the genus or mahogany tree family, is neither true mahogany nor any kind of mahogany. And the experts justified the findings of the Commission that the woods imported from the Philippine Islands and sold by respondent as "Philippine Mahogany" are not from any tree of the Meliaceæ family.'

"The court also approved the Commission's finding that the Philippine wood was not mahogany from a commercial or usable standpoint.

"Subsequently numerous other concerns entered into stipulations with the Commission to desist from calling the wood mahogany.

"The anomalous situation is now presented that whilst six business and manufacturing concerns are restrained by final judgments of the Federal Courts of Appeal from representing the Philippine wood as mahogany, by the decision now rendered in this case, the remainder of the furniture trade is left free to represent it to be mahogany.

"Another lamentable result of the present decision of the Commission is that the deceptive calling of the Philippine wood mahogany is, according to substantial testimony in the record, causing the public to lose confidence in or desire for mahogany and to turn to other kinds of material."

"Mural" Not Registrable

THE United States Radiator Corporation, of Detroit, Michigan, is not entitled to register, under the Act of 1905, the word "Mural" as a trademark for heating radiators since the word is merely descriptive of the goods or of the character thereof, according to a recent decision by First Assistant Commissioner Kinnan.

In his decision, after noting that there are radiators, as shown by the record, which are susceptible of being mounted or installed in an enclosure within a wall and others which are supported by brackets fastened to the wall, the First Assistant Commissioner said: "From the foregoing it is apparent there is among these various types of radiators a class or a type which is known and readily distinguished as wall radiators, and the word sought to be registered is used upon this type as well as upon other types."

And then, after referring to dictionary definitions of the word "mural," he said: "It is evident that when used alone in connection with goods of the character to which applicant applies it, the word has no other known meaning than that noted in these dictionaries. To those familiar with the different types of radiators, this word appearing on a wall radiator would, it is deemed, mean only that the radiator is of that type; that is, the word would be merely descriptive of such a radiator."

Must Not Sell Below Cost

THE Federal Trade Commission has ordered Noma Electric Corporation, New York, manufacturers of decorative electrical goods such as Christmas tree lighting outfits, to refrain from selling extension or non-extension Christmas tree lighting outfits equipped with any kind of lamps at prices which are less than the cost to the company of manufacturing such outfits, when this is done with the intent to suppress competition in the manufacture and sale of such goods.

The Commission's order followed the company's waiver of hearing and its election not to contest the Commission's complaint.

Inventive Genius Active

INVENTIVE genius appears to be more active now than under normal business conditions, according to R. Potter Campbell, chairman of Campbell, Peterson & Co., Inc. The company acts as agent for new products and processes.

"An analysis begun a year ago has been a revelation to us," said Mr. Campbell. "We have been impressed by the steady flow of new products, devices, componnds, and processes from Germany, Austria, France, Czechoslovakia, Poland, South America, Australia, and other countries. Inventive genius appears to be far more active at this time than in normal periods because of the desire of the scientist and inventor to increase emoluments."

Suit to Compel Patent Grants is Permitted

THE statutory provisions, section 4915 of the Revised Statutes, giving, in certain cases, to an applicant for a patent whose application has been refused by the Commissioner of Patents a remedy by a suit in equity in a district court of the United States, has just been held constitutional by Judge Simons of the District Court for the Eastern District of Michigan, reports *The United States Daily*.

Although originally enacted in 1836, the validity of the statute was challenged for the first time, according to Judge Simons' opinion, in the case in which he has just rendered a memorandum opinion.

The jurisdiction of the district court to entertain a suit under the law by which a judgement was sought that the applicant was entitled to a patent was challenged on the ground that Congress lacked power under the judicial article of the Constitution to grant such power to the district courts.

Two of the defendants supported their contention that the statute was invalid, according to the opinion, by the two following propositions:

"1. This suit is not a case or controversy, because not in such form that the judicial power is capable of acting upon it, since the contentions of all adverse parties are not submitted to the court for adjudication.

"2. This suit calls for mere administrative or advisory or declaratory action."

After reviewing decisions of the Supreme Court relative to remedies given in courts from decisions of other administrative tribunals, Judge Simons concluded that section 4915 was constitutional and that Congress had power under the Constitution to enact it.

The decision was handed down in the case of Cleveland Trust Co. v. Nelson et al. It arose out of interference proceedings in the Patent Office. The Commissioner of Patents had not been joined as a party defendant in the suit at the time Judge Simons' opinion was handed down.

Books SELECTED BY THE EDITORS

A HISTORY OF CHEMISTRY

By F. J. Moore, late Prof. Organic Chem., and revised by William T. Hall, Asso. Prof. Analytical Chem. Both of Mass. Inst. Tech.

A TREATMENT of the historical development of the important theories of chemistry and the personalities of the great men whose efforts have contributed to that development. In this revision much new material has been added. Brief biographical sketches of a number of brilliant chemists who died during the last twelve years are given. An additional chapter is devoted to Americans who did much to develop chemistry in this country.—$3.20 postpaid.

THE WAVE MECHANICS OF FREE ELECTRONS

By G. P. Thompson, Prof. Nat. Philos., Univ. Aberdeen

"AN attempt to state the principles and applications of the new wave mechanics, in so far as these concern electrons not forming part of an atom, using the minimum of mathematics." So says the preface. The "minimum of mathematics" mentioned is the calculus. Of course it is impossible to make this subject simple and at the same time get very far into its real substance. The author—who by the way is the same Thompson (son of the famous J. Arthur Thompson) whose experiments on gold films had much to do with demonstrating the truthfulness of the wave atom concept—is to be congratulated on this book.—$2.65 postpaid.—*A. G. I.*

RADIATIONS FROM RADIOACTIVE SUBSTANCES

By Sir Ernest Rutherford, Dr. James Chadwick and Dr. C. D. Ellis

SIR ERNEST RUTHERFORD'S name always will be associated in a leading way with radioactivity, and thus this book might be said to proceed from the fountainhead of information on that subject. It is authoritative and brings the whole field up to date. It is not an elementary work, neither is it a veritable nightmare of higher mathematics. The reader should, however, have some knowledge of mathematics and modern physics. As a reference book this outstanding work will be invaluable. 575 text pages, illustrated.—$6.75 postpaid.—*A. G. I.*

INTERNAL-COMBUSTION ENGINES

By H. E. Degler, Prof. Mech. Engr., Texas Univ.

AN elementary treatise considering only the things which form an important part in the development of this subject and describing engines and auxiliaries which are commonly used. Principles of operation, construction, performance—both stationary and portable—are treated thoroughly, yet concisely. A certain knowledge of the principles of the flow of heat and the operation of steam engines is assumed. —$2.15 postpaid.

EXPERIMENTAL MECHANICS

By A. Frederick Collins

ANOTHER of this uniform experimental series from which you can gather the fundamentals of engineering without any background of previous study. A series of simple and useful experiments with mechanical movements and directions of how to make them out of pasteboard. All devices described are illustrated by simple line drawings.—$2.15 postpaid.

ECONOMICS FOR ENGINEERS

By Edison L. Bowers, Asst. Prof. Economics, and Henry Rowntree, Instr. in Economics. Both of Ohio State Univ.

THIS is practical presentation of economic principles and problems for engineers and engineering students. The treatment is as concise as possible and emphasizes the engineering aspects of economic theory and business activity. The discussion of costs and pricing is especially thorough. Some aspects of business activity, such as marketing, investments, and insurance, not ordinarily included in texts on economics, are treated here for the convenience of the engineering audience to whom the book is addressed.—$4.20 postpaid.

SPEED

By Frank Hawks

UNDOUBTEDLY one of the most interesting books on aviation that has appeared. It recounts events in a most colorful career, gives sane reasons for his continuing marvelous flights and is written in unusually easy and convincing style. An adventure story entirely without technical instruction, but the facts one gleans add considerably to the history of flight and point a convincing finger to future development. Altogether a most delightful and instructing story.—$2.65 postpaid.

THE CONQUEST OF THE ATLANTIC BY AIR

By Charles Dixon

WE all have read items in the news concerning the transatlantic flights but nowhere before have all the known details of all the flights, both successful and unsuccessful, been collected. Here one will find many important points which have been missed in the day-to-day accounts and it all makes most interesting reading. Historically this book is significant for it places on permanent record the true stories when they can be written with greatest fidelity to authenticated reports.—$2.65 postpaid.

GLIDING AND SOARING

By Percival and Mat White

THERE have been several books on gliding issued comparatively r ly, but [illegible] concise, clear, and conclusive as this one is. A profusion of diagrams, photographs, and drawings explain many confusing points for the beginner, while aerodynamics and construction data form a valuable reference for the more expert pilot. Many executives of commercially operated airlines believe the future development of gliding will do more to assist aviation than anything else.—$2.65 postpaid.

TELEVISION, ITS METHODS AND USES

By Edgar H. Felix, M. I. R. E.

THE authors of books on television which have so far appeared, have, in general, been content to deal solely with the electrical and mechanical phases of the art and to pass over with little or no mention the questions which hold the greatest interest to the average person. The present work turns the revealing light of conservative judgment, backed by technical knowledge, on the television scene and reveals it in its true perspective. Television is imperfect and

the realization of television in the average home is still around the corner—but the corner may be far, far away. In order that the reader may grasp the entire situation, a goodly part of this book has been devoted to a straightforward description of various television systems as they exist today. Then are answered such questions as: When will television arrive? How will it be commercialized? What kind of television entertainment may we expect? The logic is unassailable as it is based on cold facts, and a reading of this book will tell the interested person all he needs to know of television systems, their drawbacks and advantages.—$2.65 postpaid.—*A. P. P.*

UP FROM THE APE

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By Milton Mayer and John Moore

THIS book contains 28 short essays on topical subjects, mainly scientific, and makes interesting reading of the lighter kind. The authors are inclined to dramatize science, both where there is drama and where there is not, the style being rather strenuous and a bit "newspapery." However the sketches are interesting and the reader would get his money's worth even if the publisher had not padded the book so heavily with thick paper and by other methods.—$2.65 postpaid.—*A. G. I.*

THE WAY TO RECOVERY

By Sir George Paish

THE present crisis is the most serious the world has ever experienced and the most difficult to adjust. Only by a calm analysis of the underlying conditions and a frank facing of the truth, whereby national aspirations and jealousies can be restrained in the interest of fair and equitable apportionments to all, will a way be found out. Unlimited credits for a time is the author's solution and in quite a convincing way he develops this theme. Broadmindedness and an attitude of brotherhood toward all, mark the clear thinking which this book contains. It may well be thoughtfully read by all of us.—$2.15 postpaid.

SCIENTIFIC AMERICAN
ADVERTISERS

OCTOBER · 1931

GEORGE A. TOWNSEND Mid Western Advertising Manager
6 North Michigan Ave Chicago Ill

BLANCHARD NICHOLS COLEMAN
Western Advertising Representative Los Angeles San Francisco Seattle and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Formerly Munn & Co Inc. 24-26 West 40th Street, New York

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JOHN P DAVIS Treasurer — I SHELDON TILNEY Secretary

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NOVEMBER · 1931 35 CENTS

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Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · NOVEMBER · 1931

SCIENTIFIC AMERICAN, November 1931, Vol. 145, No. 5 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879: additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Copyrighted 1931 by Scientific American Publishing Company. Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00.

ACROSS THE EDITOR'S DESK

IT is with a sense of personal loss and a feeling of sincere regret that we record the death of Dr. David Starr Jordan, world-renowned educator and man of science. For many years Dr. Jordan was associated with SCIENTIFIC AMERICAN as a contributing editor, and we have always regarded him as one of our most valuable friends. Born at Gainesville, New York, on January 19, 1851, Dr. Jordan died on September 19, 1931 at Stanford University, California, after a prolonged illness.

Dr. Jordan graduated from Cornell University in 1872. In 1891 he became head of the Leland Stanford memorial university, continuing in that capacity for more than 20 years. The post of Chancellor Emeritus was then created for him, in order to allow him more time for his scientific investigations. He held high rank in the field of natural history, and was regarded as one of the leading authorities in ichthyology.

DURING the rush of prosperity which accompanied the World War, industry grew by leaps and bounds. Riding on the crest of the war-raised wave of booming business, new industries grew overnight from old, brought into being by new ideas which lent themselves to immediate application. But along with these applied ideas were conceived others which, at first sight, seemed to be impractical. They were discarded at the insistence of high-pressure production demands, and were forgotten. Then came 1921 and depression. Something had to be done, and in no small way were these discarded ideas responsible for the prosperity that returned and reigned for the greater part of the last decade. They were brought to light, subjected to intensive research, and furnished the bases for new and improved products. Possibly the same process will be the means of breaking the present business dead-lock. In the article "A Chemist Looks at Business Cycles" D. H. Killeffer reviews past performances of business, and gives some refreshing views of future possibilities. The article, founded on unassailable facts, will appear next month.

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Rickets, the bone disease that afflicts more than half of the babies in the north temperate zone, has received a new and effective set-back in the form of milk in which the vitamin-D content has been increased 20 to 30 times that which is normally present. The background of the work which makes this vitamin-content increase possible, and the commercial methods that are now being used to place the treated milk in the hands of the public, forms the subject of an article to be published soon. It will be of vital interest to all parents of small children, and to everyone concerned with the future of the race.

•

The history of Poland has been one to arouse sympathy in the hearts of all liberty loving peoples. With the end of the World War and the establishment of a new Polish nation, the Poles responded with vigor to the problem of building up their country to modern standards. One of their greatest accomplishments has been the establishment of a huge seaport at Gdynia, through which products of the nation may pass unhindered to the markets of the world. The engineering aspects of the seaport development have been incorporated in an illustrated article scheduled for publication next month.

•

We are all familiar with the phenomenon of ocean tides, but few realize that there are tides in the seemingly solid crust of the earth, and that they also are caused by the gravitational attraction of the moon. Harlan T. Stetson, director of the Perkins Observatory, has prepared an article, soon to appear in these pages, in which he describes the research work that is being directed toward a more complete knowledge of these earth tides. For example, he says: "Investigations now in progress . . . show that the latitude of a given place on the earth's surface varies, not only with the month . . . but depends . . . upon the position of the moon in the sky. . . ."

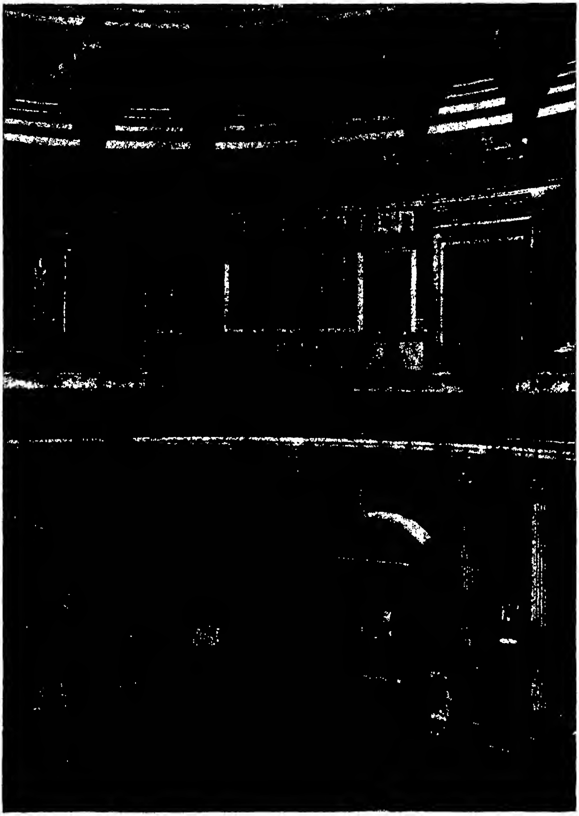
•

In the early days of the West, mines were the principle source of wealth, but the situation has now changed and the mining industry has declined to a fraction of its former importance. Today the principle resource of the same section is water—water applied by scientific irrigation to render fertile the vast regions of arid land. Just what water means to the West, and what is being done to conserve it and apply it properly, is told in a forthcoming article.

Orson D. Munn

LINUS PAULING

HAILED as a prodigy of American science, Linus Pauling, who at 30 has published nearly 50 papers in original research, and who has won a full professorship in the California Institute of Technology, has been awarded the A. C. Langmuir prize of the American Chemical Society. Prof. Arthur A. Noyes, director of the Gates Chemical Laboratory of the Institute, and described as "a severe critic," characterized Pauling as "the most promising young man with whom I have ever come in contact in my many years of teaching." Dr. A. C. Langmuir, sponsor of the prize of 1000 dollars, called Pauling "a rising star, who may yet win the Nobel Prize." In singling out Pauling, he explained, American chemists, breaking with tradition, are honoring a scientist at the threshold instead of at the sunset of his career. The work of Pauling has had to do with crystal structure, the quantum theory of the dielectric constant of gases, atomic and molecular structure, and determination of the nature of chemical bonds. Prof. Pauling was born in Oregon.



ROME'S SPLENDID PANTHEON RESTORED

THE Pantheon of Rome is the only edifice in the Eternal City with walls and vaulting in a complete state of preservation. It was erected in 27 B.C., struck by lightning in 110 A.D., and rebuilt by the Emperor Hadrian. The dome is 142 feet in diameter. The building contains tombs of several celebrated men including Raphael. Attention has been recently called to it by the removal of the whitewash and plaster of 1746 which overspread the beautiful attic story above the columns, revealing the beautiful slabs of marble, porphyry, and serpentine.

An ancient extinct volcano, Mount Mikeno, is in the gorilla sanctuary of the Parc National Albert, where Carl Akeley rests

AFRICA'S FIRST NATIONAL PARK

By MARY L. JOBE AKELEY

Secretary of the American Committee for Scientific Research in the Parc National Albert, Belgian Congo

IF you travel along the Equator westward from Mombasa, the Indian Ocean port of entry to old British East Africa, r Kenya Colony, or if you journey northward along the Westward Great Rift Valley of Africa, you will reach almost the geographical center of the great continent—a country still wild and unspoiled by man. This region, known as the Kivu District of the Belgian Congo, is west of Victoria Nyanza and north of Lake Tanganyika. When in 1908 King Leopold presented the Congo as a free gift to the Belgian people and it became a colony of Belgium under the name of the Belgian Congo, the Kivu was practically an untouched wilderness, peopled only by savage blacks and by the most primitive of all natives—the pygmies (*Batwa*). Since that day few white men have penetrated its vastnesses. Almost without any outside interference or influence, the black man has dwelt there, has cultivated his tiny *shambas* (gardens) or has hunted the game that roamed at will over a land unchanged throughout many centuries.

Belgian civilization has marched steadily up the Congo River; it has overspread even the valleys of its tributaries. The great Belgian Congo colony has developed enormously since the World War and its riches in copper, gold, diamonds, radium ore, cobalt, tin, and other minerals, as well as its agricultural products make it one of the greatest material assets of the Belgian nation.

In this wild area there is little conflict between economic development and scientific interest. The rolling lands around Lake Kivu are well adapted to agriculture and are rapidly coming under cultivation, but the great volcanoes adjacent to the Lake, as well as the sandy and swampy lands in the north about Lake Edward, are unfit for spade or plow.

Four years after the searchlight of interest had been turned upon the almost unknown volcanic region by Carl Akeley, [illegible] il Albert was created by Albert, King of Belgians, in 1925. This far-sighted act was Carl Akeley's am come true—that this beautiful spot should become a ctuary for all wild life. His chief interest was the preserva- i of the mountain gorilla, most interesting of all anthro- [illegible] i the primitive forest of rare and age-old trees—the gorilla's home. His original plea, in 1922, afte [illegible] Mus [illegible] Natural History, was for a complete sanctuary [illegible] square in the uplands of the [illegible]

A beautiful bit of African scenery showing the paper bark tree and the mossy platforms and profusion of ferns

Warmly sympathetic to this idea was Dr. John C. Merriam, President of the Carnegie Institution, who in turn advocated the cause to Baron de Cartier de Marchienne, then Belgian Ambassador to the United States. Several months before, Mr. Akeley had interested the Belgian Ambassador in the results of the gorilla expedition and his plan of conservation. Accordingly, early in 1924, the Ambassador began active efforts with his home government to the end that not only the small area of the reservation be secured, but that a larger outlying tract of land be set aside as additional protection to the gorilla. Seconding the efforts of Baron de Cartier with unremitting devotion, was the Belgian Consul-General at Baltimore, James Gustavus Whitely.

It was on March 2, 1925, that King Albert created by Royal Decree the Parc National Albert, Kivu District, Belgian Congo, as a sanctuary where not only animals, but also plants and natural scenery would be perpetually preserved, and where scientists from all over the world would eventually be permitted to come to study the flora and fauna of Africa under the most primitive conditions.

In the years immediately preceding 1922, with an ever increasing influx of big game hunters and natural scientists into the Belgian Colony, the last refuge of many unusual species, the Belgian Government recognized the necessity of permitting a certain number of such rare animals to be taken for strictly scientific purposes. It has consistently endeavored, however, to preserve these rare species and also to prevent the wanton destruction of other less rare, but harmless animals, the slaughter of which serves no useful purpose.

THE Belgian Colonial Authorities now found it necessary to restrict not only private hunting expeditions, but also certain expeditions contemplated by museums and other scientific bodies. Conceding that among the rare animals most in danger of extinction the mountain gorilla ranked preeminent, the 1925 decree, in the interests of humanity as well as science, preserved the remaining gorillas from extermination.

President Henry Fairfield Osborn from the beginning not only had been in warm sympathy with the idea of gorilla protection, but he had also been deeply interested in the possibilities spot in the Kivu. Receiving from the Belgian Government an invitation for the American Museum of Natural History to participate in plans for scientific development and research in the gorilla volcanoes, he added to his personal and official interest a unanimous resolution of co-operation expressed by the trustees of the American Museum of Natural History.

Where gorillas roam near Kivu volcano. Carl Akeley used this pretty scene in connection with a gorilla group for exhibition

During the two years after the conclusion of the 1926-27 Akeley-Eastman-Pomeroy African Expedition, the noted Belgian zoologist and conservationist, Dr. J. M. Derscheid, our companion in the Congo, and the author collaborated in proposals to enlarge the area of the park; to emphasize most strongly the necessity of preserving in the park all wild and natural conditions as they now exist; to save in their ancestral way of living some of the primitive African pygmies, a race now threatened by extinction; to maintain the spirit and essential character of the Royal Decree, as stated in its opening words: "The Parc is created for scientific ends."

The project is now well under way. The park area has been increased from 60,000 acres (the original area set aside) to 500,000 acres. In October, 1929, an unprecedented event occurred in Brussels—the establishment and inauguration of an International Commission of 21 scientists for the control of scientific research in the park.

As we were gathered in the *Palais des Academies*, we were deeply impressed by the words of King Albert, who described the widely diversified scientific opportunities of the park—"a region not only of interest to geologists and mineralogists, but remarkable from the point of view of ethnography, since Bantu and Hamitic elements as well as and, by no means least, remarkable from the point of view of biology, since the wide range of its altitudes allows several life zones to meet and gives rise to flora and fauna infinitely rich and varied."

"No other region of the African continent," said His Majesty, "offers such wide opportunity for scientific study and for the installation of scientific research stations which would be easily accessible in a climate almost ideal for the white race.

"IN our day there is much zeal, and rightly so, for the preservation of the monuments left us by the past. Here, in the Belgian Congo, you have also a primitive monument to conserve—a monument created by Nature during the course of thousands of years. Before you stands a great work to be achieved. In opening up and maintaining this exceptionally interesting region for the benefit of scientific research, Belgium will make a new contribution to the progress and application of science."

On this occasion, Drs. Merriam and Osborn were named as the American members of this International Commission, and the establishment of an American Committee for Scientific Research in the Parc National Albert was determined upon at the same time. His Highness Prince Albert de Ligne, then Belgian Ambassador to the United States, was named president* and the author was made secretary of this committee. The purpose of the American Committee is to bring the Parc and other similar undertakings in Belgian Africa in closer contact with American scientific and conservation organizations, and to secure support for these projects.

At a meeting of the American Committee, held recently at the American Museum of Natural History, New York, Dr. Derscheid, now *Administrateur-General* of the Parc, reported its progress to his colleagues, and told them of plans for the further extension of the park system in Belgian Africa. In addition to the Parc National Albert, there will be created a new park, Parc Leopold, near the northern border of the Congo. It will comprise an area of 1,000,000 acres. Lying north and east of Parc National Albert will be another new park, the Parc Ruwenzori, an area of 500,000 acres in the Ruwenzori Range, adjoining the Belgian Congo-

British Uganda boundary. These new regions are of great scientific interest, since this new park extension will protect such rare mammals as the white rhino, the Okapi, and the Giant Derby eland.

Pending the official establishment of these new parks, activity has been concentrated in the Parc National Albert. Patrols of native scouts are on guard to prevent the killing of animals or the destruction of plant life. Meanwhile the Belgian Government has appropriated ample funds for the maintenance of the Park Service, and has advanced a loan of two million francs to begin immediate construction of a Central Station for Scientific Research. Certain limited areas will be closed even to human entrance, except as emergency may require. Entrance into the Parc will be rigidly supervised, since it is desirable that frequenters of the preserve be scientists and students, with a sympathetic and understanding interest in the work to be accomplished.

THE important point of scientific interest in the Parc is the triangle comprising the three ancient volcanoes, Mikeno, Karisimbi, and Bishoke, which rise beyond the palm-fringed equatorial Rutshuru River into the heights of frequent and long-enduring snows. Here in this small area are all the zones of climate of the earth—fervid heat, salutary mildness, biting cold. Clothed in gloriously beautiful vegetation—the bamboo, the mixed forest, the cold forest of giant trees—the old volcanoes afford rich forage for elephant, buffalo, and the strange, man-like mountain gorilla.

Below these extinct volcanoes are wide lava plains, sparsely vegetated and inhabited only by a few families of lion. In one rare spot, a small hill above the lava plains, dwells the chimpanzee.

Bird life is abundant and varied. Birds that live so high on these mountains might well be expected to resemble the birds of the north, and we find here doves, ravens, thrushes, titmice, and woodpeckers.

Two magnificent lakes are outstanding in this Kivu district of the Province Orientale. Lake Kivu is at the southern end of the territory. It is the highest and most spectacular of the central African equatorial lakes. Five thousand feet above the sea, often two thousand feet in depth, its clear and sparkling waters are flanked by rolling hills and rugged headlands. In marked contrast, Lake Edward in the northern part of the district is much lower in elevation. Its shallow turbid waters teem with animal life; its shores and adjoining grassy, sandy plains are hot, affording range lands for large herds of antelope—all the species found in East Africa, and found nowhere else in the Congo; its swamplands and affluent rivers harbor herds of hippo.

More than two miles above the sea level are the active volcanoes of Nyamlagira and Nyiragongo, devoid of animal life. Their eternal fires tinge sky and fleecy cloud by day and flame like giant beacons perpetually throughout the night.

But it is the high reaches of the forest-clad volcanoes of Mikeno, Karisimbi, and Bishoke that compel the greatest interest. You may go from the open spaces of the lower foothills, dotted with occasional trees and shrubs ablaze with scarlet blossoms, into the smoke-like gloom of dense bamboos, through which broad roadways run here and there, where an elephant herd has crossed your ascending route.

Here you have your first view of the gorilla's feeding grounds. Bamboos torn and scattered and twisted show where the hungry ape has fed on the young and tender shoots, sweetly-bitter and pale pink in color. You taste them and find them by no means unpalatable. Above the bamboos you enter the vast cold forest where gigantic trees with ponderous, sprawling branches impress you as nothing you have ever seen before. They are draped in heavy moss, hung with long, swaying ferns, and brightened by gay orchids. The upper reaches above timberline are clothed in giant heaths and senecios and immortelles that almost fringe the dead crater's rim.

Skeleton map of Africa showing the location of the gorilla country and the park

AS you follow the steep upward trail, progress is made possible only by half a dozen natives who go ahead hacking down the dense undergrowth—where sturdy bamboo and brilliant begonia, dainty fern and hostile nettle grow side by side; where vast beds of wild celery crowd into blackberry thickets 12 feet in height; where giant parasite lobelias thrive alike in rotting logs or growing trees; where shining laurels grow among rare flowering plants you have never seen before. It is indeed a veritable fairyland that the natives open up to you with their sharp, hand-wrought axes—a land of almost unearthly beauty which you are so laboriously penetrating.

It is at the 11,000 foot altitude that you see the forest at its best, at the very beginning of *Kanyanamagufa* (Canyon of Death) along which you have listened to the singing stream or glimpsed its shining waterfalls in the depths below. The forest is soaked in mist or rain. It grows increasingly cold. You will need warm clothing for wear by day and warmer still when in your camp at night. But when the sun breaks through the gray and white cumulus clouds or when the winds sweep clear the rugged summits of the volcanoes, then you have a sight worth traveling, as you must have done, half 'round the world to see.

The pygmies are the most curious and primitive of all natives in the still untouched Kivu region, where they hunt game and cultivate their tiny gardens

Everywhere is an untouched, unspoiled Paradise. The glorious living trees adorned with great platforms of golden-green moss stretch their branches not upwards to the sky but almost horizontally like giant arms beckoning you to pause there and learn the unrevealed mysteries of this world. Vivid orchids grow in moss or roughened bark, long fern fronds cling in fluttering draperies to every mossy platform, veils of grey-beard moss adorn massive trunk or lesser branch.

In all the open spaces wild celery grows in great abundance—often its feathery topmost leaves are above your head—its dense-growing, succulent, spicy stalks invariably impede your progress. It remains for the gorilla to do as he likes in the "celery patch"—his favorite feeding ground. There is no mistaking where he feeds. He pulls up the heavy stalks of wild celery, strips off the tough outer husks and gorges on the tender hearts and juicy roots. After one morning's feeding a family of 20 gorillas will make a celery patch 100 yards square look desolate. But their food supply is by no means precarious. A week after they have fed, the spot is covered with long new shoots and soon the wild celery is everywhere growing as luxuriantly as it was before the gorillas visited it.

A view of the Kivu forest in the gorilla country

FROM their feeding grounds, their trails—wide and distinct—lead out to other pastures or to semi-open spots among the trees where they build their beds for rest and sleep throughout the long afternoons and nights. These beds are prepared by pulling together dry vines and sticks and moss, and by fashioning them into a comfortable resting place. Sometimes they are quite exposed in the open, sometimes in the dry earth under an overhanging and protecting tree. Mother and babies too old to rest in their mother's arms sleep side by side. Father gorilla's bed is nearby.

Once in a very long while, a half-grown gorilla climbs a few feet up to an overspreading branch and there, close to the family, he builds his bed in the thick foliage. There he is out of harm's way if a hungry leopard invades their camp.

Among the bamboos, throughout the cold forest and up even to the sub-alpine zone, the buffalo ranges. His trails criss-cross those of the great apes, but there is peace between them because there is no conflict of economic interest. There is plenty of forage for gorilla, elephant, and buffalo.

Here, in this enchantment, is now established Africa's first national park. When Carl Akeley first visited the home of the mountain gorilla in 1921 to collect a group for the American Museum of Natural History, he was not only struck by the beauty of this region but he was also amazed to find apparently so few gorillas inhabiting it. While homeward bound on the Red Sea, his idea of a gorilla sanctuary took definite shape. He wrote to Judge Paul Salkin, Elizabethville, Katanga, Belgian Congo, that he had found the gorilla "a wholly acceptable citizen and not the wicked villain of popular belief;" that he is "a splendid animal in every sense, in no sense aggressive or inclined to look for trouble," and that even the largest male, a magnificent creature weighing 380 pounds, like all the others secured by the expedition, showed only a disposition to get out of danger.

Even in face of the fact that my husband's 1921 investigations were confined to a few weeks, he was, nevertheless, confident that the gorillas were limited in numbers—not the thousands as represented by the professional hunters then interested in gorilla hunting for sport. He found them healthy and not unusually wild. In fact many of the gorillas he met were unconcerned—some even climbing up on an overhanging tree trunk to get a better view of him while he made the first motion pictures ever made of live wild gorillas in their native haunts.

Left: The gorillas make "nests" or beds by pulling together vines, sticks, and moss. *Right:* Native ring of a is n

OUR POINT OF VIEW

Whose Fault is It?

"WILL you please send me a picture of an atom, or pictures of several kinds of atoms, with exact dimensions?" Letters expressing substantially this thought are received quite frequently by the editors of all scientific journals, from persons who are sincere in the belief that exact answers can be given.

One inclines at first to smile. But hold—has anyone a right to smile? Who is responsible for leading people to think it possible for a true picture of an atom of matter to be available from scientists? The defendants are two. Neither is really guilty of intent to mislead anyone, but the information in misleading form has nevertheless reached the public. When the physicist describes an atom or draws a sketch of one he is generally speaking to physicists, and he knows they know he refers only to an imaginary concept—one which is only in the process of development and subject to merciless modification. When the popularizer of science picks up such transient concepts and sets them before general readers as if they were established facts he is either guilty or ignorant. Yet, as sundry books and articles reveal, this is being done every day.

Nobody has ever seen an electron. Nobody has ever seen an atom. Nobody has ever seen even a molecule. If our most powerful microscope were about a thousand times stronger than it is, and if there were no other obstacles, some of the molecules—the largest ones—could be brought into our ken provided they would stop their eternal dance and "stay put" long enough to be viewed. We deduce our mental "picture" of these particles from indirect evidence—from the way they act when we put them through various performances. But, just as a blind man could deduce a certain picture of a trained flea by the results of certain experiments on it, yet go wrong time after time, so science deduces a picture of the atom; and like the blind man with the flea, science goes wrong again and again.

The latest "model" of the atom is not a model at all. The closest concept of it is not close at all; it is the Greek letter *psi*. This stands for "electric density" and that is about as near as we can come to picturing it in our minds. As later and later styles in atoms are set, the trend seems to be away from comprehensibility, not toward it, for the average man. Popular writers should be frank about this and not put science in the position of knowing things concerning which it is largely ignorant. With matters going on as they are, the public is gradually becoming cynical, and wonders whether science after all is not largely bunk. Whose fault is it?

Building for Parity

EIGHTEEN months have passed since representatives of Great Britain, Japan, and the United States affixed their signatures to the London naval armament treaty by which the 5-5-3 principle of the Washington Treaty of 1922 on capital ships was extended to cover other categories. And yet, despite our successful fight to be allowed parity with Britain, we have not outlined a program by which we may attain it. It is true that Secretary of the Navy Charles Francis Adams announced early in August the Navy's new policy to put the London Treaty in effect, but at the time this is being written, nothing definite has been done.

Recent figures given out by the Navy Department show that while the building programs of all the signatory nations lag behind the construction permissible for 1930 and 1931, that of the United States lags worst of all. These figures and those given in the SCIENTIFIC AMERICAN Digest of this issue show that we should be building in the calendar years 1930 and 1931 a total of 116,740 tons. Congress, however, provided for laying down *no ships* during these two years and appropriated, on the 1931 program, for only 11 destroyers, with an aggregate tonnage of 16,500, which were authorized in 1916! Great Britain has appropriated for more than four times as much tonnage as has the United States since the London Treaty; France, if we include a program for 1930-1931 approved just before the treaty was signed and another program proposed for 1931-1932, has projected four and one half times as much tonnage; Italy has appropriated for twice as much; and Japan has approved a plan that will bring her to full treaty strength. So far as the United States is concerned, there *is* a naval holiday!

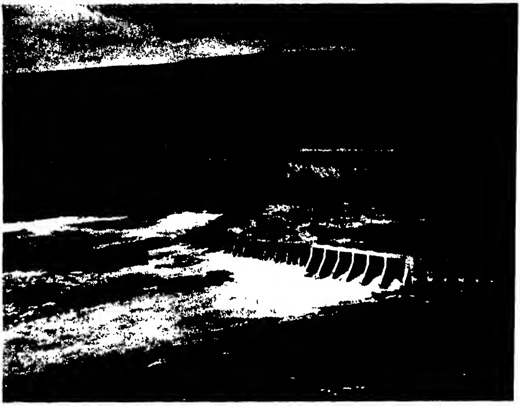
The United States obtained parity with Great Britain—on paper—and now it is up to the nation to achieve it on the high seas. Popular demand should see to that. It is true, of course, that such a demand would place the Administration in an embarrassing position: with a steadily growing Treasury deficit, Mr. Hoover has to consider national economy almost, we might say, ahead of all other things. This desire for economy, however, would be balanced to a large extent by the aid a well-considered naval building program would give to the unemployment situation and to the many industries which would be called upon to supply the materials needed. There is a happy medium somewhere between the two extremes and the nation will look to Mr. Hoover and the Navy to find it.

A False Alarm

TAKE heed! In 10 years, or at least no more than 20, our supplies of natural gas will be exhausted! The conservationist voiced this warning 30 years ago and has been repeating it ever since. Fortunately for the unheeding people who have used this natural wealth extravagantly, his prediction was short-sighted and unnecessarily gloomy.

A short time ago a pipe line to bring natural gas from Texas to Chicago, a distance of over 900 miles, was completed and placed in operation. This is the longest of an ever-growing number of long pipe lines that have been laid to carry the precious fuel; it taps a reservoir which, even though its gaseous product be consumed at the rate of a half billion cubic feet a day, will not be exhausted for 100 years. Looking at other fields, we find that the two which supply San Francisco with 400,000,000 cubic feet daily will last for 75 years; others are being exploited more fully than heretofore; still others are being brought into production.

This does not mean that we may waste our natural gas with impunity, but it does mean that there is enough to supply our industrial and domestic needs for some time to come. And it is not too much to expect that by the time our natural gas supplies have become exhausted, fuel technology will have progressed to the stage where distillations from coal will take their place. As it is at present, artificial, or manufactured, coal-gas is used to dilute the natural gas because the latter is too rich for ordinary use. In the future, coal may furnish all the gas that is needed; and we have enough coal to last several thousands years.



A panoramic view of the hydroelectric development at Rock Island in the Columbia Rive

POWER DEVELOPMENT ON

By T. B. PARKER*

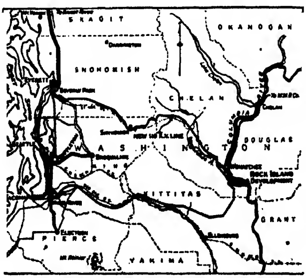
THE Columbia River is one of the most famous streams in North America, and in earlier days formed the gateway to the Northwest. It drains a large portion of the great basin which lies between the Rocky Mountains and the Cascade Range, including parts of Washington, Oregon, Idaho, Montana, Nevada, Wyoming, and British Columbia. The total drainage area is about 259,000 square miles, of which about 89,000 square miles are tributary to the power site at Rock Island where a dam is being built to harness the waters of this river for the first time.

This upper portion of the Columbia watershed includes a large number of lakes, glaciers, and snow-covered mountain ranges, s that the dry season flow i remarkably well sustained. The lowest measured flow at Rock Island was about 21,000 cubic feet per second, which is a very considerable amount of water. Some idea of this quantity may be gained by imagining a stream 210 feet wide and 20 feet deep, flowing with a velocity of five feet per second. The maximum flood on record since 1858 occurred in 1894, and was estimated at 740,000 cubic feet per second. The discharge of the Columbia River shows a remarkable regularity in its seasonal variations. The larger floods occur in June or July, while from October 1 to April 1 the flow rarely exceeds 100,000 cubic feet per second.

The Rock Island Hydroelectric Development, now under construction, is located on the Columbia River about 12 miles downstream from the city of Wenatchee, Washington, and thus is adjacent to the famous Wenatchee fruit-growing district. It is being built for the Puget Sound Power & Light Company, which is the principal distributor of power in western Washington. This development will have several novel features, and will be the first large low head development in the Northwest.

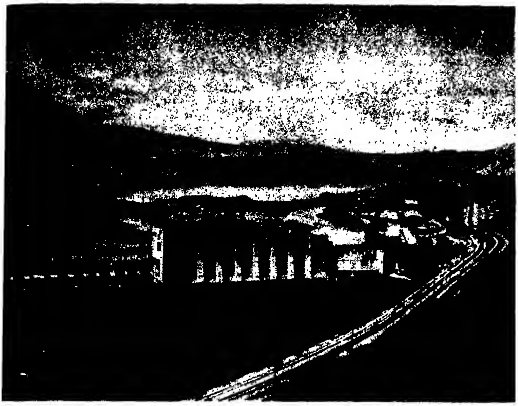
At the island which gives the project its name, the river divides into two nearly equal branches, and flows with considerable turbulence through a rocky gorge about half a mile long. At low water, the total drop i about 15 feet; at high water about 7 feet. When the dam is completed to its ultimate height, a maximum head of nearly 51 feet will be available at low water. It is not planned, however, to develop this full head until necessary to meet load requirements.

For larger flows in the river, the head is greatly diminished, and it is the production of the necessary power under a reduced head which is one of the most interesting features of this development. During a flood equal to the highest flow recorded since 1894, the minimum head will be about 20 feet.



Map showing location of Rock Island development

*Project Engineer, Stone & Webster Engineering Corporation, Boston.



This photograph, taken from downstream, shows the work as completed at the time of writing

THE COLUMBIA RIVER

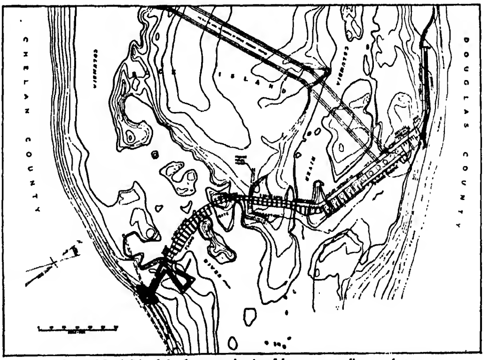
Fortunately the maximum reduction in head will always take place during June or July. Since the capacity of other water power plants on the same system is at a maximum in the summer, it follows that during the period when the generating capacity at Rock Island is reduced by high water, the demands for output from this plant will also be less.

The development has been planned on the basis of an ultimate capacity of ten 15,000-kilowatt generating units, with provision for the possible later addition of two more 15,000-kilowatt units should this prove desirable. The initial installation will be four units, or 60,000 kilowatts.

The power house is located in the east channel at an angle with the direction of flow. It is connected to the east bank by means of a gravity bulkhead section, and with the island by a gate controlled spillway. A similar spillway is being constructed across the west channel.

The power house has a number of unusual features. Owing to the necessity of providing for possible extreme high water, all windows and exterior openings have been omitted from the building up to the main deck, which is about on a level with the roof of the generator room. This conditi has made it i y to provide extensive drainage, ventilating, and lighting systems.

The water wheels have been designed with a view to producing as much power as possible under a reduced head without sacrificing too much efficiency under normal conditions. Although designed to operate efficiently under a head of 50 feet, these wheels will develop 21,000 horsepower to normai generator capacity, when the head is reduced to 32 feet. For a head of 20 feet,



Plan of Rock Island development, showing fishways, power lines, and so on

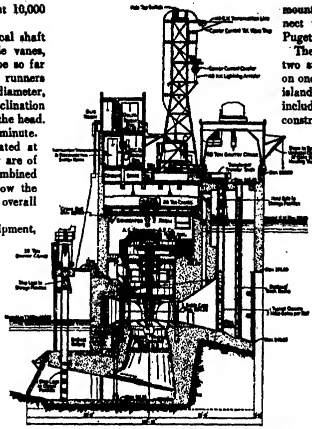
each wheel will produce about 10,000 horsepower.

The wheels are of the vertical shaft propeller type with adjustable vanes, and are the largest of this type so far installed in this country. The runners are about 18 feet 7 inches in diameter, and have six vanes each, the inclination of which can be varied to suit the head. The speed is 100 revolutions per minute.

The generators are each rated at 16,667 kva., 13,800 volts. They are of the umbrella type with combined thrust and guide bearing below the rotor. Each stator has an overall diameter of 28 feet 8 inches.

The 13,800-volt switching equipment, the main and station service control equipment, and two banks of three 13,800 to 110,000 volt, single phase transformers for the two outgoing high tension circuits are located on the roof of the generator room.

The topography at Rock Island is very favorable in that a dam with the required crest elevation has a comparatively low average height. On the other hand it is necessary to offer very little obstruction to the flow of the river during extreme floods, in order to avoid raising the water level upstream. The result is a spillway consisting mainly of a massive concrete sill upon which are constructed concrete gate piers seven feet thick and 30 feet apart in the clear. The piers support a reinforced concrete deck from which the flood gates will be operated.



A cross-section of the main unit of the power station in the Rock Island development showing all the details

ALMOST as well known as the Columbia River itself is the Columbia River salmon. Every spring and summer enormous numbers of these fish return to the river to breed. Finding their way by some remarkable instinct from the ocean to the place of their birth, they pass up the main stream, over rapids, and through all obstructions, finally arriving in the shallow waters of the tributaries where they spawn and die. The fisheries industry is one of the largest in the northwest, and it is essential to the continuance of this industry that there be no serious interference with fish migrations on the principal rivers.

In the case of the Rock Island development the government required the immediate construction of two fish ladders, which when completed will probably be the largest of their kind. These fish ladders have proved to be one of the major problems of the entire development, because of their large size. Each ladder will be of rock and concrete, 500 feet long and 20 feet wide with a slope up and downstream of 1 to 10. One is located on the east and one on the west bank of the river, each along the downstream side of a concrete abutment section, with openings through the abutment at various levels to allow a flow of water into the fishway and to permit the upstream passage of fish into the reservoir.

Power from the Rock Island development will be transmitted at 110,000 volts over lines which will cross the mountains at favorable points and connect with existing substations of the Puget Sound Power & Light Company.

Looking up one of the completed fishways built by government order

The project is being constructed in two stages by diverting the river first on one and then on the other side of the island. The east channel structures, including the power house, are being constructed first. The low water period, during which it is possible to divert the river, usually extends from September to April, inclusive, so that it has been necessary to do most of the work during this part of the year. Cofferdams in the east channel were started in February 1930, in order to get as much of this preliminary work as possible out of the way before the following construction season. Both upstream and downstream cofferdams were completed to within 10 feet of their ultimate heights before the spring floods.

DURING the late spring and summer, water continued to pass over the cofferdams, reaching a maximum depth of 11 feet over the upper cribs, but causing very little damage. During this period active work on the job was confined to the assembling of construction plant and equipment. Very low water conditions returned in the late summer and by the last of August the space between the cofferdams was completely pumped out. Work was immediately pushed as rapidly as possible on the excavation and concrete work in order to avoid pouring concrete during cold weather.

Cofferdams in the west channel were started in February, 1931. The downstream barrier was completed to its full height, and the upstream coffer to within 10 feet of its ultimate height before being topped by high water.

During the 1931 high water season the station superstructure has been built and much of the equipment installed. As soon as the floods recede water will be diverted from the west channel through gate openings in the east channel structures and the west channel spillway will be constructed. It is expected to have the plant entirely completed and all units ready for commercial operation by August 1, 1932.

Stone & Webster Engineering Corporation have the contract for the design and construction of the entire development. All construction is under the general direction of W. D. Shannon, general superintendent, and H. F. Anthony, project manager. R. E. McGrew is superintendent at the Rock Island Station, and T. H. Campbell, superintendent on the line construction.

UNITED STATES PLANT PATENT NO. 1

By ORSON D. MUNN
Member of the New York Bar

THE first United States plant patent has been issued. Henry F. Bosenberg of New Brunswick, New Jersey, has the honor of being recognized as the first person, under the amendments to our patent statutes, to invent or discover and asexually* reproduce, a "dis-
ing
or trailing rose. This ro
known or used by others in this
ntry, befor
;of, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application (for patent), and not in public use or on sale in this country for more than two years prior to his application," and not abandoned. Therefore, on Mr. Bosenberg's application, which was filed on August 6, 1930, Plant Patent No. 1 was granted to his assignee, Louis C. Schubert, of New Brunswick, New Jersey, on August 18, 1931, who thus becomes the first person in the United States to whom a patent for a plant has ever been granted.

SUCH patents are granted under Sec. 4886 of the Revised Statutes, as amended by the Act of Congress approved May 23, 1930. "Tuber-propagated plants" are excluded from the benefits of the law.

An inspection of this patent and the drawing which constitutes a part of it, shows that it is for a "climbing or trailing rose," and that apparently the only identifying characteristic which serves to distinguish it from other climbing and trailing roses is its so-called "everblooming habit."

The claim of the patent is as follows: "A climbing rose as herein shown and described, characterized by its everblooming habit."

This claim must be read in connection with a disclaiming clause found in the patent, which reads: "No claim is made as to novelty in color or other physical characteristics of the individual blossoms, nor as to the foliage or growing habits of this rose other than as described above."

The patentee has this to say as to the "everblooming habit": "When

Reproduction of drawings accompanying specifications for Plant Patent No. 1

grown in the latitude of New Brunswick, New Jersey, my new climbing rose, named 'The New Dawn' and illustrated herewith in exact drawings from photographs, provides a succession of blossoms on a single plant from about the end of May to the middle of November, or until stopped by frost."

Patents for plants, like patents for other inventions, secure to the owner of the patent the right to exclude all others from exercising the invention, or from "infringing," as it is technically known. The interpretation of this patent and the scope of the rights secured to the patentee, if it shall ever be used as a basis of a suit for infringement, will raise some nice questions, not only of law, but in the science of botany.

Congress recognized that the granting of such patents might require of the Commissioner of Patents a knowledge of botany which he may not possess, and it therefore provided that "The President, by executive order, may direct the Secretary of Agriculture to furnish the Commissioner of Patents such available information of the Department of Agriculture, or to con-
ugh the appropriate bureau
on of the department such
rch upon special problems
(submitted by t
detail to the Commissioner of Patents such officers or employes of the department, as the Commissioner may request for the purposes of carrying this Act into effect."

HOW shall these plant patents be interpreted? What are the rights secured? What do they cover? All these questions must be asked by one who desires to respect such patents and not be charged with infringement, as well as by the courts who may be called upon to enforce such patents against infringers. How are we to identify infringements? For example, "Plant Patent No. 1" claims as the peculiar characteristic the "everblooming habit" of the climbing or trailing rose. This characteristic, "a succession of blossoms on a single plant from about the end of May to the middle of November," is apparently the distinguishing characteristic of such a rose plant "when grown in the latitude of New Brunswick, New Jersey." Would this characteristic be the same if such rose plants were grown in Charleston, South Carolina, or in Portland, Oregon, a city famed for its roses, or in any other part of the country?

Sec. 4884, as amended by the Act of Congress referred to, provides that such a plant patent grants to the patentee, his heirs or assigns, for a limited period (17 years from its date), "the exclusive right to reproduce asexually the plant."

It would seem that the exclusive right granted by this provision can be of little commercial value to the patentee. However, the true value of a plant patent can be determined only after a legal battle has been fought and ultimately decided by the Supreme Court. Such a decision will have a definite bearing on the future success of all plant patents granted.

*"Asexual Reproduction.—Fission.—The simplest form of asexual reproduction is called fission. It is restricted to unicellular organisms and is the sole method of reproduction
ployed by the most primitive plants. It con-
erely in the division of a single-celled
ual into two protoplasts of equal size.
new individuals, produced by fis-
r contain all the materials of the
arent cell."
ok of General Botany," Holman and
, Published by John Wiley & Sons,
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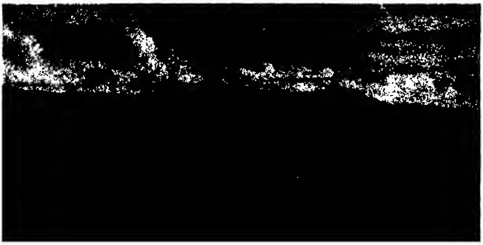

In the previous two numbers photographs taken at Mount Wilson Observatory by Dr. Ferdinand Ellerman of the Observatory staff were shown. At left and at right are two more of this series. The first one is a view looking east from the Observatory, showing the mountains in typical autumn condition. The one at the right

THE HOTTEST PLACE IN THE UNIVERSE

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE question "What keeps the stars shining?" is far from being fully answered, but the answer has been one of the most fertile sources of new ideas in astrophysics. We told last month of the possibility that the internal supply of heat may be maintained by the building up of atoms—hydrogen being, so to speak, the fuel and the heavier atoms the ashes—and touched only casually upon the alternative possibility that a still greater source of heat may be found in the destruction of atoms—the disappearance of the electrical charges of which they are composed and the liberation of the enormous corresponding amount of energy. Such a process would be more than a hundred times more powerful as a source of heat than atom building. May we believe that it really happens within the stars?

"Doctors disagree" very decidedly about the answer, but so much of interest is involved in their very disagreement that the unfinished tale is worth telling.

The trouble is that our present knowledge of atoms indicates that, while the transformation of matter into energy is theoretically possible, it should happen only at exceedingly high temperatures. Atom building, according to Professor Atkinson, may happen inside the stars at temperatures of about 20-000,000 degrees. But, according to the recent work of Professor Milne of Oxford, the disappearance of atoms with the heat would begin to occur only at a temperature thousands of times greater. So, before we can say very much more about this problem, we must find out if we can how hot the stars are inside.

We could do this if only we knew what the density and the pressure of the gas were at a given point inside the star, say at the center. To be sure, we would have to know also something about the nature of this gas—the average weight of the particles of which it is composed. But inside a star we know that the atoms are thoroughly broken apart into loose electrons and heavy nuclei, and the heavier the nucleus the more free electrons there are to bring down the average, which comes out much the same for all kinds of atoms. The simple assumption that the average weight is that of an ordinary hydrogen atom will lead us to about the right temperature. If the gas is really composed of metallic vapors our first estimate must be approximately doubled. If it is all hydrogen it must be halved (because each hydrogen atom is split into two parts). But we will very rarely be wrong by more than a factor of two.

SUPPOSE now that we had a mass of gas as big and heavy as the sun and that it was of uniform density throughout. Very simple calculations then show that the temperature at the center, on our standard assumption, would be 11,000,000 degrees, Centigrade. For different materials it would vary from 5½ to about 25 million. Of course there is no reason to suppose that the sun or any other star is of uniform density. There is no doubt that the surface is far less dense and the center much denser than the average. If we knew how much greater the density was at the center and how it diminished toward the surface, to calculate the pressure would be a perfectly definite problem. The greater the central density the greater the pressure there. But the two rise together, so that the temperature, which depends on the ratio of the two, does not change so much. It can be shown indeed that, even if the central density were a hundred times the average for the whole star, the central atom would at most be only a little more than four times the value already calculated. Unless the central condensation is greater than this, the temperature at the sun's center must be between 5 and 100 million degrees—which is not hot enough to permit the annihilation of atoms, though adequate to set off the atom building processes.

For stars of different masses and sizes (but built alike as regards the increase of density toward the center) the temperature should be proportional to the mass divided by the radius. Applying this rule to the numerous stars whose masses and diameters we know or can estimate, we find that the central temperature should be a good deal the same as in the sun for all the stars of the "main sequence," which includes Sirius, Procyon, the sun, and the faint and red dwarf stars. The very white and massive stars, like those of Orion, may be two or three times as hot inside. For the cooler giant stars such as Capella, Arcturus, and Antares the internal temperatures come out much lower. The only stars which can be much hotter inside than the sun (provided always that they are built in-

shows fog on the same mountains, a summer condition. Feature-by-feature comparison of the two photographs will reveal that the fog-surrounded "hill" of the one is the mountaintop of the other. A fog cascade is seen to be pouring out of the more distant valley across the shoulder of the nearby ridge, very much as if it were water

ternally in more or less the same fashion) are the white dwarfs, like the Companion of Sirius, which are of very small size and high density. The central temperature of such a star may be 20 or 30 times as great as the sun's, and may reach a billion degrees or perhaps more.

If stars of other kinds (that is, the vast majority of those visible with our telescopes) derive their energy from the annihilation of atoms inside them, it appears that they must possess an enormous concentration of mass toward the center. It will not suffice if the central density is 100 or even a 1000 times the average; there must be a small central core in which the density is something like 1,000,000 times that of a star as a whole.

THERE is nothing physically absurd about the existence of such a dense core. The "stripped atoms" inside a star are of exceedingly small size, as are also the free electrons, and under sufficiently great pressure they might be crowded together far more closely than is possible for atoms of ordinary matter in which the outer "orbits" of the electrons are of much greater dimensions. Eddington pointed out some years ago that this remarkable condition of matter occurs in the interior of the white dwarfs. But it is only recently that the possibility of a similar dense region inside ordinary stars has been seriously considered at Milne's suggestion.

We can calculate most of the properties of the gaseous matter inside a star fairly well, including the opacity or the resistance which it offers to the escape of heat toward the surface. If we could only calculate also from theoretical considerations the rate at which heat is produced in each part of the gas it would be possible by a rather complicated calculation to find just what internal distribution of density would give an exact balance between the heat produced inside each part of the star and that which escapes to the surface, and so find out just how the star was built. Unfortunately, nobody yet knows definitely how the heat is produced nor at what rate, so that the best anyone can do is to make some reasonable guess about it and work out the consequences. Several investigators have tried this, among them Milne. Starting with simple assumptions which had already led Eddington to his well-known model with the central density 54 times the average, he found that other solutions were also mathematically possible in which the central density was enormously greater. These had one disadvantage: at the very center the density came out infinite!

This seemed absurd at first glance, but it depends on the assumption that the simple "gas laws" which were used in the calculations hold good, no matter how greatly the gas may be compressed. There is good reason to believe that this is not true, and that even under the highest pressures a gas could not be compressed beyond a certain limiting density. If this fact should be taken into account mathematically the solutions would doubtless lead, not to an infinite density but to a small region at the center where the material compressed by the weight of the overlying layers reached almost the highest possible density—that is, just the small dense core which we have seen is the *sine qua non* for a very high central temperature.

The first stages of the diminished compressibility can be worked out from the quantum theory, and it is found that in the interior of a smallish star, say of half the mass of the sun, the density would reach several hundred times that of water, but get no further. A mass of gas with its center in this condition, and of course with layers of ordinary compressed gas of lower density in its outer regions, would be very strikingly similar in size and density to the actual white dwarfs, and it appears that these once problematical bodies are beautifully explained by Milne's calculations.

Inside more massive stars, where the pressures are still greater, it appears that the density may be still greater. No one has yet dared to set a limit, but it may be very high indeed.

IT is possible, then, that many or indeed all of the stars have at their very centers small, enormously dense, and exceedingly hot regions within which the annihilation of atoms may actually be taking place. If this is true these minute cores may be the sources of practically all the stars' heat supply, the outer regions acting only as a blanket to keep it from escaping too fast.

Whether this picturesque state of things actually occurs, and if so where among the stars, must remain uncertain until theoretical physics is in a position to predict more about the heat generating process. But the recognition of its possibility is a step forward.

A few years ago Eddington, writing upon this problem at a time when it appeared reasonable to believe that the internal temperatures of ordinary stars were at most of the order of 50,000,000 degrees, referred to the difficulty that such a temperature seemed theoretically "inadequate to account for any appreciable annihilation or transmutation of matter," but concluded: "We do not argue with the critic who tells us that the stars are not hot enough for this process; we tell him to go and find *a hotter place*."

Sir Arthur's jest was much appreciated by his colleagues, but for some years his challenge went unanswered. Now Prof. Milne has met it seriously and it may be that the "hotter" place really exists.—*Lowell Observatory.*

FORD, THE PRACTICAL

By EDWIN P. NORWOOD

OF the many articles that have been written about Ford and Ford methods, some have been commendatory while others have been censorious. Only too often these express personal opinions and may or may not be accurate in detail. The writer of the accompanying article, however, bases his discussion on the evidence of his own eyes, having had the opportunity to observe Mr. Ford almost daily—and at all times during the day's work—for many months. He thus is able to picture a side of Ford that is little known, a side which, whatever may be one's personal opinion of the man, provides for all an object lesson in perseverance and attention to details. There is no doubt that industry has learned something from his methods. May it not also learn something from the man himself and particularly from a consideration of his way of getting things done?—The Editor.

MANY titles have attached themselves to Henry Ford. He is variously referred to as the automobile king, the world's richest man, Ford the educator, Ford the philosopher, and Ford the farmer. Aside from his automotive plants that extend around the globe, he personally maintains a huge private hospital, an even larger educational institution—the Edison Institute of Technology—and operates Trade Schools for boys. A recent compilation reveals that his activities embrace fully 35 major occupations, trades, and manufacturing lines, to say nothing of minor ones. And yet first, last, and all the time, he is, more than anything else "Ford, The Practical."

Looking back over three score years to his childhood, he recently remarked, "My toys were all tools. They still are."

The sole difference between that day and this is that the kit has grown greatly in size.

Picture, if you will, a motor truck chassis raised upon jacks. Seated underneath, on chance-may-offer boxes, are several men in animated discussion—one gray haired and wiry of build.

Again, visualize a pleasure car standing on the floor of an experimental laboratory and once more the gray haired man in earnest discussion with another. Suddenly you see the older man motion to the other. You see them hitch themselves under the car, roll on their backs, and continue their debate.

FOCUS such scenes in the mind's eye and you will have a mental picture of Henry Ford in action. You will have an idea of that forthrightness of movement characteristic of him when getting at some mooted point relative to one of those cars or trucks, more than 20 million of which have borne or still bear his name.

There is an old saying that forthright men "take off their coats." Ford doesn't waste that much time. He is too quick in thought, in action, and in speech for that.

And yet nothing in which he has a hand is ever done in a hurry. The atmosphere around Henry Ford is one of calm. He does not surround himself with fussy or what we are pleased to call "peppy" men. He has never been a believer in the modern "pep" philosophy. He surprises men with the amount of time he has. He has time for everything except watching the clock. Instead of confining his activities to a certain number of "office hours," and then racing through them, he utilizes all or any part of each 24 hours. Though sponsor of the eight-hour day and five-day week he would be the last man in the world to apply any such rule to himself. He reduces hurry, not by crowding time but by making use of all that is at his disposal.

It cannot be said that Henry Ford is irregular in his habits of work; yet he has no routine. It is never certain where he will be at a given time. He starts out in the morning and goes where his "hunches" lead him. But he is always somewhere, doing something. It is not at all surprising to find him in the Dearborn shops at 6:30 A.M. On these visits it is said of him that he sees more in 10 minutes than most eyes take in during as many hours.

Several years ago he noted a man using emery paper on a motor block. Two hours later an order had gone out to dispense with this article in connection with all operations where flecks from such paper might become embedded in bearing surfaces. That one glance and that quick decision started a months' long quest for an abrasive that would do the work yet not endanger the life of car parts so vital as crankshafts and cylinder blocks.

Evening often finds him in the research laboratory that he has erected in Greenfield Village for his Trade School graduates. He works at the bench with them, as they seek new uses for the earth's products.

"What do you call yourselves?" the writer recently asked one of these youthful chemists.

"Students," was the response. "That is what Mr. Ford says he is, you know."

At two in the morning this same man may be working in his own laboratory which is built in [illegible] at Dearborn. Waking in the night, he gets an idea. And with Henry Ford, an idea is a worthless thing unless steps are taken to project it in practice. Of him, Edison has said, "I take off my hat to Ford for his knack of finding the best and simplest way to do things mechanical that baffle experts."

NIGHT work is no new experience to him. It is but a repetition of what he did 40 years ago when he labored with his first gas buggy on Bagley street, in Detroit. At 68 he is still finding better ways of doing things.

He is a good sleeper, but he finds a total of six or, perhaps, seven hours sufficient for him. He has an office but is seldom in it. His appointments are usually kept in some one of a dozen offices other than his own. If yours is with him you will find him essentially "easy to meet." A laden office boy drops a paper and Henry Ford picks it up for him. He speaks to everyone who passes him or whom he passes. Nine times out of ten he stops to shake hands.

He is modest but this is the result of innate philosophy rather than meekness. Recently a caller congratulated him upon his "inventions connected with the first automobile."

"I never invented anything," he answered. "Everything is here. We just put old things to new uses."

In other words, as he sees it, all the laws of mechanics have always existed. Thinkers have merely ferreted them out and put them to practical use. Thus it follows that he believes anything can be done. Nothing is impossible.

"The newest, latest thing in existence is a person; the finest thing in the world is mind. The coarsest thing is the earth. Bring mind and matter together and

almost anything is likely to happen."

He refuses to give up. He has no use for a quitter, much less a loafer. If a man says to Henry Ford, "I can't do that," Henry Ford usually takes him at his word, unless his keen eyes inform him that the man can do it. Many have found they can do the impossible for him. He often quotes, "My friend is he who makes me do what I can." When a young man bristled somewhat at Ford's correction, Ford simply said,

"Look here, I don't waste time trying to fix anything that's not worth fixing."

The left handed compliment induced the young fellow to go after his problem again.

The manner in which the man works is illustrated by a story of a certain part now used in the Model A engine. Mr. Ford had himself conceived the idea of a simplified assembly. To reduce the part to the desired simplicity required machinery which would fashion two split guide bushings and hold their outside diameter, when paired around the stem, to within three ten-thousandths of an inch. All else was ready for production. Then weeks and even months passed while men worked to produce the needed part. Finally some of the staunchest men in the plant began to doubt. One of them decided to have it out with "the boss." He reported the lack of progress.

"How many have we made?" Ford asked.

"There they are—probably a hundred of them."

"And how many of them are right?"

"Not more than two or three."

"Two or three!" Ford shot back. "Then we've got it! Just go ahead and make them all like those two or three."

TRANSLATE the foregoing paragraphs into higher wage scales for men, shorter hours and shorter weeks for labor, quantity production by means of conveyor lines—any number of things—and they will tersely tell exactly the same story.

"To see a thing clearly in the mind is to make it take form," Henry Ford will tell you. "Concentrate on a job and you will attract all the things necessary to accomplish it. You attract the things to which you give a lot of thought. I have had to quit many jobs and wait—because I hadn't spent enough thought on them."

Henry Ford has always had sufficient means to carry on even his earliest engineering experiments. This statement will probably come as a surprise to many readers, for popular notion runs to the contrary. People are incorrigibly romantic where public men are concerned. If a man reaches the White House, they like to think he came from a log cabin. If a man attains wealth they prefer to believe he rose from extreme poverty. Many stories have been told of Henry Ford's early poverty. There is the mythical turkey that he could not afford on Thanksgiving; and the legendary milk he could not provide for a sick baby. The fact is, the Fords were well-to-do for their times. Ford's father was a warden of the Episcopal church, a justice of the peace, the owner of a first class farm, and the possessor of a home which even in this day would be rated comfortable. Henry Ford himself has always been able to support himself on a well-to-do scale. When he worked in a saw mill he owned the mill. While it is true that his highest wages prior to entering motor manufacturing were 100 dollars a month, it is to be remembered that such an amount 30 years ago was considered a top-notch salary. The truth is, there has been no poverty interlude in Henry Ford's life. He has always found something to do. Indeed, his experience with work lies at the basis of his personal philosophy: that if a man starts to work at anything useful, whether he is hired to do it or not, he has set in operation forces which will link him with necessary support. He is convinced that every man has a self starter which will always work, given the proper incentive.

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HENRY FORD

What of his present wealth? Again the approach is that of the engineer:

"Wealth is only a tool to do things with. It is like the fuel that runs the furnace or the power that turns a wheel—only a means to an end. And the end is a better sort of life for the last family."

ARE THERE CREATURES LIKE

By EDWIN LINCOLN MOSELEY
Professor of Biology,
Ohio State College

AS Alexander of old yearned for more worlds to conquer, so modern man, having conquered land and sea, and at last the air, would like to extend his activities to other realms. What is the evidence that he could exist on other worlds or that some of the heavenly bodies are already peopled with man-like creatures?

New interest in this absorbing question has been aroused by recent determinations of the temperatures of some of the planets. We do not expect to find life where water could not exist except in the form of ice or steam. If we consider the vast distances that separate us from even the nearest of the heavenly bodies, it seems almost inconceivable that we could ever ascertain the temperature of any of them. This feat has been accomplished, however, not with thermometers but by using very sensitive galvanometers connected with miniature thermo-couples in vacuum cells. By directing a very large telescope toward one of the nearer planets and concentrating the rays upon a thermo-couple it has been possible to find out approximately the planet's temperature. This differs on different parts of the planet, just as it does on the earth. Likewise the temperature at one place changes as the planet turns on its axis and exposes the place to more or less of the sun's rays. In this way it has been found that the temperature of the equatorial region of Mars rises, when the sun gets high in the heavens, to some 50° Fahrenheit or higher.

THERE is evidence that oxygen exists in Mars' atmosphere, as well as a little water vapor, although probably less than in the air above the deserts on the earth. The atmosphere of Mars appears to be less dense than that at the top of Mount Everest, which no human being has yet been able to reach because of insufficient oxygen in such a rarefied atmosphere.

Inasmuch as the temperature of the equatorial region of Mars rises well above the freezing point in the middle of the day and both water and oxygen are probably present, it may be stated that as yet we know nothing that would absolutely preclude the continued existence of life upon that planet, although conditions there seem less favorable for life than on the most desolate parts of the earth. On the other hand, there is no evidence which appeals to the majority of astronomers that life of any kind actually exists on Mars. The dark areas, which were formerly interpreted as due to vegetation, have been found to have a higher temperature than the other parts of Mars' surface, whereas if they were covered with trees or other plants they should be cooler. They are probably lower and more moist than the surrounding regions.

"If there were a building on Mars 100 times as large as the Capitol of the United States, it could not be seen with the best telescopes on the earth. . . . ."

If there were a building on Mars 100 times as large as the Capitol of the United States, it could not be seen with the best telescopes on the earth, although with these telescopes it is possible at times to observe the tiny satellites that revolve around the planet. This is equivalent to seeing a baseball at a distance of some 200 miles. No living thing, even if 10,000 times the size of an elephant, could be detected at the distance of Mars or of any other planet.

With the exception of the moon and sun no other heavenly body is so well known as Mars. Venus, as she follows her path around the sun, comes nearer to us than Mars ever does. But when nearest, Venus is between us and the sun, so that in looking at her we must face the sun or the brilliantly illuminated sky near it and—what is more important—look at the side of Venus which is dark because it is turned away from the sun and so is not illuminated. Moreover, this planet seems to be completely enveloped in clouds all of the time, so that even with the best telescopes no permanent markings are visible. But spectroscopic examinations of the light from Venus indicate that the quantity of oxygen in her atmosphere is quite too small to sustain life.

As to other planets in the solar system and their satellites, their great distance or the circumstance that they are continually enveloped in clouds has prevented our learning much about their fitness for life. Mercury, the nearest planet to the sun, probably keeps the same side continually facing the sun, just as the moon continually presents the same side to the earth. The side of Mercury which is receiving heat from the sun is too hot and the other side too cold for any life. In a narrow region along the border of the hot and cold parts it is conceivable that living things could exist.

The planets more remote from the sun than Mars have such a low density as to indicate that there is nothing solid in them, unless it be in the central part. Moreover, it is probable that all of them are too cold to sustain life.

So far we have been considering the possibility of human life on planets which in the remote past formed parts of the sun and still continue to accompany the sun in its journey through space. As the earth is also one of the children of the sun, it never wanders so far from the others that light requires more than a few minutes to traverse the space that intervenes. Let us now leave the solar system and turn our attention to other parts of the universe.

ALTHOUGH the stars do not appear to be more remote than the planets, yet all are so distant that the light which enables us to see them has been years, instead of minutes, in reaching us. Only a few thousands of stars can be distinctly seen with the unaided eye but many millions are visible with telescopes, and still other millions have been photographed with long exposures of plates in cameras attached to large telescopes that are moved by accurate clocks to prevent the earth's rotation from shifting the image on the plate. Because of their great distance these telescopic stars are so faint that the combined light from a million of them would not be perceived by the retina of the human eye. Yet among all these millions of heavenly bodies not one could in its present condition support life of any kind. All are too hot. If they were not so hot as to emit a strong light, they would be invisible from the earth. We call them stars but if they were no farther from us than the sun most of them would appear to be fully as large and brilliant as the sun, if indeed their heat did not destroy us.

The only *visible* heavenly bodies which are cool enough to support life are members of the solar system—bodies which revolve about the same sun around which the earth revolves.

OURSELVES IN OTHER WORLDS?

One of these, Jupiter, is some 1300 times the size of the earth. If it were removed from the solar system and placed in the neighborhood of the nearest star it would not be visible with the best telescope on earth, unless it were to give out many times as much light as it or any other planet gives out now.

While it is probable that no life of any sort exists on a single one among the many millions of bodies which have been seen in the heavens, the case may be different if we consider those that have not been seen. We are inclined to underestimate the importance of many of those things which we are not able to behold with our eyes. We know from the motions of certain stars, together with the fact that at regular intervals they become dimmer and after a short time regain their brightness, that they are accompanied by dark companions which at such times shut off part of their light. It may be that many visible stars are associated with others which we cannot see and which in their revolutions do not come between us and their bright companions. Moreover, it was at one time thought that most of the stars resemble the one we call the sun in having a retinue of planets. Their distance from the earth is so great that if this were true we should not be able to see these planets. Of late years, however, many astronomers have believed that the sun is nearly exceptional in having planets about it. Our sun is believed to have given birth to the bodies that revolve around it, as the result of some great star passing so near as to cause a prodigious tide and disruption which tore them away from it. Only once in the billions of years of solar history has such a thing happened to the sun. To most of the stars it may never have happened. They are so far from other stars that approaches close enough to evoke any tidal disruption would not by chance occur in many billions of years.[1]

RECENTLY this idea has been modified by the following consideration: The part of the universe which we call the Milky Way or galaxy, and which contains virtually all the stars which can be seen individually even with the aid of the largest telescopes, has long been expanding. The stars of which it is composed are probably kept from wandering beyond the region of the galaxy by the attraction of the whole mass. In recent years we have learned that radiation from a hot body causes a gradual reduction of its mass. For trillions of years the stars of the galaxy have been radiating vast quantities of energy and so their mass has been decreasing. Accordingly their power to attract one another has been decreasing and so they have become more widely separated than they were formerly.

By E. C. Slipher, Lowell Observatory (Sanger)

Mars. The pair at top are direct photographs, the larger one below is a drawing, and the remaining one is a photograph of the same drawing made at a distance through same telescope as were the top pair

This means that trillions of years ago the stars of the galaxy were not nearly so far apart as now and so the chance of near approach to other stars in the galaxy was much greater than now, affording more frequent occasions for disruption. Consequently, many stars may, like the sun, be accompanied by a retinue of planets and satellites.

If, however, of all the stars known to the astronomers—that is, all the stars in the entire universe—only one in a thousand has any planets revolving around it, and if in turn only one in a thousand of these planets possesses enough water and such an atmosphere and temperature as would make life possible, still the number of such planets capable of supporting life would amount to millions.

In view of what precedes we may say that in the present state of our knowledge of the universe we have reason to *infer* that the earth is only one of many orbs that are fit for the abode of living things. However, worlds that are suitable for life would never become inhabited unless at some time living creatures had been carried to them or else had originated upon them. We know nothing of the origin of life upon the earth. So far as our observation goes every individual has come from some individual that existed before. This is true of both plants and animals. We know of no instance of even the lowliest form of living things springing into existence without a parent or parents. That they have done so sometime, somewhere upon the earth, seems less improbable than that the first life was brought to the earth from some other place.

IF, however, life has originated once upon the earth, then why may it not have arisen more than once? If within our own time life had originated again and again in the ocean, our failure to observe it would not be remarkable, when we consider how ignorant we still are of many of the higher and larger forms of marine life, to say nothing of those of microscopic size. Outside the ocean it seems improbable that life ever has originated upon the earth. All freshwater creatures and all terrestrial forms of life have probably been derived in the course of ages from those that lived in the sea. For this reason it is probable that on those celestial orbs which, like Mars, are without seas, life has never started.

Every organism seems to be well adapted by its structure and habits to live successfully in the region where it is found. That those regions from which it is absent are unsuited to its existence is a natural inference, but is far from expressing the whole truth. No one ever saw a starling in Cleveland, Ohio, until recently. Now thousands may be seen at one time in the air over Cleveland's public square. The ocean was an insuperable barrier to European starlings, English sparrows, and ring-necked pheasants. Yet, when brought to America by man, they thrived as well or better than in their native land. The same is true of rabbits taken to Australia and New Zealand. The former absence of those creatures from certain continents was due to their inability to cross barriers and not to unsuitable climate or other environmental factors of the unoccupied territory.

In view of these facts it is clear that we are not warranted in assuming that every form of life which could main-

[1]Sir James Jeans estimated in 1928 that a given star's chance of forming a planetary system by this method would be one in 500,000,000,000,000,000 years. Taking our own galaxy, with 100,000,000 stars, he calculates that one star in each 100,000 would have a "solar" system; that is, theoretically, there would be 1000 such systems in the galaxy. Of course, as Sir James would be the first to admit, such calculations are not exact because direct data on which to base them are lacking. But they do at least give some idea.—*Editor.*

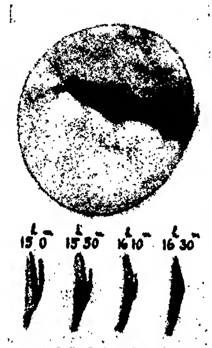
tain itself in any continent is to be found there. Those which are actually there are but a fraction of the myriads for which climatic and other conditions would make life possible. It would be even more unreasonable to suppose that every celestial orb, where temperature, atmosphere, and moisture resemble those on the earth, is inhabited by creatures closely resembling those that live on the earth. If there are very many bodies in the heavens whose exterior closely resembles the earth's exterior, it is quite possible that on some of them a somewhat similar flora and fauna has developed.

That a person would ever be able to fly across the ocean seemed a foolish speculation a few years ago. Now the younger generation is ready to believe that human ingenuity will sometime make it possible for a person to be carried by a rocket or some other device to another planet. They will at least admit that colonization of other orbs by people from our own has not yet taken place.

WE are so much concerned with the life of man that to think of a world teeming with living things, but without any people, requires quite a stretch of the imagination. Yet our own world for hundreds of millions of years supported plants and animals of a great number and variety without any that resemble man more than a fish or frog. The time that has elapsed since the first human beings appeared may be a million years, but it is only a very small fraction of the time since life first started on the earth. If several of the planets, or the satellites which accompany them in their revolutions around the sun, were able to support life, it seems improbable that in the course of their slow development they would arrive at the stage where human beings would come into existence at approximately the same time as on the earth.

The fallacy of assuming that human life must exist in all those places where such life is possible may be shown in other ways. Before the ancestors of the Indians and Eskimos came to America from the Old World, there was no creature on this side of the earth more like man than are the prehensile-tailed monkeys of South America. Yet man had been living in Eurasia for hundreds of thousands of years. Were it not for his migrations, America would be without human inhabitants now and probably for all time. If men have never originated in the Western Hemisphere, where conditions for human life are so favorable, how much likelihood is there of their evolving on a planet whose physical conditions probably differ from those of the earth to a much greater extent than the Western differs from the Eastern Hemisphere?

Man does not bear a strong resemblance to anything in the animal kingdom except the mammals. It is inconceivable that he could have developed from any other class. It is probable that all the mammals now existing on the earth had a common origin; in other words, that their ancestors did not spring up independently in different places and in different geological periods. If no creature bearing so close a resemblance to a man as does a squirrel or a horse has ever originated anywhere in the world except by descent from the common ancestors of the mammalian class, it seems im-



Drawn by G. Van Biesbroeck, Yerkes Observatory

Drawing of Mars, through the 40-inch telescope. Extension at terminator is a cloud. The other sketches show the apparent effect of the planet's rotation on it

probable that creatures moulded in our own form have arisen otherwise on other orbs.

It is possible that in more than one place on the earth Nature has repeatedly produced the beginnings of mammalian life and that these beginnings have been unable to survive because of competition with mammals that had progressed farther and became more highly developed. In that case there seems to be no reason why creatures having many of the characteristics common to mammals on earth may not have evolved elsewhere.

If there are mammals, or animals much like them, living on many distant celestial spheres, the chance of manlike creatures having evolved on some of those spheres seems quite possible. That any of them closely resemble us seems less likely. The aborigines of Australia are descended from ancestors who in an early period of human development were separated from other people and have been isolated from the inhabitants of other continents until recent times. They differ from us in many ways. They have no domestic animals and do not cultivate the soil, but subsist on fish, lizards, snakes, insects, and such other animals as they can kill. They have no fixed abode, but when the weather is inclement they make a rude shelter of bark or brush. They wear little or no clothing. They never acquired the arts of weaving, pottery-making or smelting of ores. They have no bows and arrows, to say nothing of more formidable weapons, no written language, and according to some observers, no religion. Their women are slaves and are frightfully maltreated. Yet we call these Australians human. Like ourselves they are able to walk erect after attaining a certain age. Their hands are serviceable for more purposes than are the hands of apes, and they have greater intelligence than apes. Their features are on the whole rather more like ours than those of any of the apes, although many people of our race would hesitate to call them human.

NO instance is known of any of the types of animal life which had flourished in past ages and which had become wholly extinct ever having been evolved again in the course of the world's history. So many forms are possible that, if their development is largely a matter of chance, a particular one, such as that of man, would not often come into being. If, on the other hand, the course of evolution is determined by the surroundings of the organism, does it seem probable that in other worlds the physical and biological environment would resemble more closely what we have on our terrestrial continents than the environment on one of these continents resembles that on another? It is then very doubtful whether anywhere in other worlds there are beings which resemble us as closely as do the Black Fellows of Australia.

Among animals that have acquired the ability to walk erect, so that the fore limbs are free for other uses, increase of intelligence or learning conveys an advantage. Man has become the master of all the other large animals on the land and of many in the sea. His struggle with the insect world is still undecided. More education may enable him to conquer the insects. If intelligence gives an advantage in this world, why not in others? In some of them the evolution of superior beings has probably been going on longer than on the earth and under more favorable conditions. We may well believe that whether those beings look like us or not, they may have surpassed us in many ways. What would we not give really to know something about them?

THE BIRTH, LIFE, AND DEATH OF A RAILROAD TICKET

By FRANCIS X. MILHOLLAND
Assistant to the Senior Vice-President, Baltimore and Ohio Railroad

"ALL tickets, please."

Every railroad traveler has heard this trite, courteous, and important request as the conductor enters the car and starts to check-up his passengers, but the ordinary person gives little thought to the origin of his ticket and what happens after the conductor has collected it. Yet the railroads have developed a science of ticketing their passengers that never fails to account for the revenue that each ticket represents to the carriers.

Long before the passenger ever thought of his trip the ticket that he buys has been prepared for him. For the purpose of having tickets readily available, there is a ticket supply department in the general offices of every railroad, with an adequate staff to prepare in advance the thousands of tickets of many different kinds. Not only must there be plenty of tickets always on hand, but the thousands of agents in the stations all along the line must be supplied with sufficient to take care of demands.

Beyond supplying, selling, and collecting of tickets is their accounting. To take care of this, there is the auditor of passenger receipts, with a large force to assemble, sort, classify, record, and indicate both the mileage and the revenue involved in each and every ticket. A ticket is handled, on the average, 15 times.

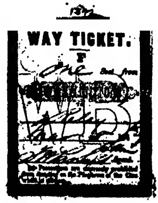
THE accounting is not as easy as it looks. If a passenger buys a ticket from Washington to New York, or from Baltimore to Chicago, for example, over the Baltimore and Ohio, it is a simple proposition. There are only to be considered the point of origin and the destination. However, should a passenger intend to go, for example, from Baltimore to San Francisco, or to Los Angeles, Portland, or Seattle, his part of purchasing the ticket and handing it over to the conductor still is simple, but the work of the railroad necessarily becomes complex. The line in question ends in the west at St. Louis, Springfield, and Chicago and beyond these points the ticket becomes a joint one with whatever railroads the passenger uses in continuing his journey.

Complications in ticketing grew as the railroads developed. When railroads were new there were no tickets. For example, when the first train ran to Frederick, Maryland, from Baltimore, the method of collecting far crude as the cars upon which passengers traveled. People who traveled on the railroad then were content to sit and tell the conductor where they were going, give their names, and produce from wallet or purse the fare to their destinations, while the conductor gravely and carefully wrote on a manifest their names, destinations, mileage to be covered, and the amount collected for

The ticket agent does more than sell tickets; he keeps books and banks the conductor's cash fares and supervises the whole office

the trip. Then as passengers to principal local points increased, card tickets with point of origin and destination printed thereon were inaugurated and furnished to ticket offices, chiefly to save time in issuing.

Railroads were constantly increasing in number, with the trend ever west-



An early one-way ticket, Washington-Relay, Md. March 5, 1847

ward, so the next question that arose regarding ticketing was to provide inter-line forms from St. Louis, Chicago, and other gateways to all points on connecting railroads. To take care of this, a separate form for each line operating beyond such gateways was deemed necessary. To simplify the process and handle the inter-line business economically there was eventually adopted what is known as a "multi-form" ticket, which in many instances resulted in the discarding of as many as ten or more of the old individual forms, thereby bringing about a very substantial reduction in the number of tickets which agents were required to carry.

AS the railroad ticket developed, so did its various kinds. The simplest is the local ticket, but its progeny are many, including the one-way, the round-trip, the excursion, the commutation, the printed destination, the clergy, the conductor's cash fare receipt, the inter-line one-way and round-trip, the skeleton form for facility in routing, and the interchangeable scrip coupon book.

The life of a railroad ticket begins in the office of the ticket supply clerk, where a copy of the prescribed form is prepared and sent to the printer for setting up in type. Proofs are checked by the rate department to insure accuracy as to junction and transfer points of connecting lines. Reference is made to various circulars and maps lest errors appear as to exchange points. After this the printer receives the order to run off the tickets in whatever quantity is desired. Upon receipt in office of the ticket supply clerk they are

filed in cases awaiting requisitions from the agents along the line. When printed, all tickets are consecutively numbered so as to be readily identified in the records.

This might be called the infantile period of the ticket's existence, for the ticket has not yet begun to move, but it does begin to move when the agents' requisitions come in. Then it steps into passive life, being taken from the ticket supply case where it has reposed and sent to the agent, who stores it in his selling case subject to call. This move is kept on record in the ticket supply office, in the agent's office, and in the auditor's office.

Now the ticket has "gone to school" and the big experiences of its life are before it. It is ready to be sold to the first customer. Suppose it be an interline ticket. The prospective passenger steps up to the window of the little station at Nappanee, Indiana and expresses a desire to go to Boston, Massachusetts. The agent takes the ticket from the case where it has been resting, stamps the date on the back, receives the proper amount and the ticket changes hands. It leaves home—for a while. Although the issuing line may not reach Boston, the interline ticket will take care of the passenger to that point, and the passenger will have no worry about procuring other tickets.

NEXT the ticket begins its active life. Under its new owner (who really seems to think a lot of it for he carefully puts it safely away) it is brought out and shown to the gateman, who punches it to show that the passenger has received endorsement and is privileged to enter the train.

After the train is in motion, the ticket is shown to the train conductor as well as to the Pullman conductor, and the passenger announces his intention of stopping over in Washington, D. C. The train conductor then punches the Nappanee to New York coupon of the ticket, indicating that he has honored it to the end of his run, and writes on the back of the coupon, "Off at Wash., D. C."

Distinctive ticket punches are furnished to the division superintendents by the ticket supply clerk and the division superintendents give them to the conductors on their respective divisions. Each punch, different from any other, tells an interesting story to the initiated.

If the destination shown on a ticket be a point on the parent line, the last conductor examining the ticket and honoring it to destination would retain it and send it along with other collected tickets and his reports to the auditor of passenger receipts.

Conductors distinguish passengers in the coaches who have already turned in their tickets from those just boarding the train by issuing small train checks which are of different colors to signify various destinations, or travel zones. After selecting and punching one to suit the case before him, the conductor places it in a small metal holder on the seat. These train checks are sometimes called "hat checks" because the former custom was to stick the check in the hat-band of the passenger, but this practice is no longer in vogue as seat clips are provided.

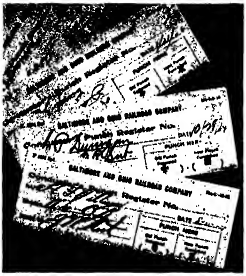
Upper: Conductor is "making up his run." Extreme accuracy is essential as not all tickets are lifted. *Below:* Operation is being reversed; clerk is "working" the run and checking up

Reverting to the inter-line ticket to Boston, the various conductors *en route*, after examining the ticket, report to the auditor of passenger receipts that they "have honored, but not lifted" it, this report being made on a special form. On the last lap of the passenger's journey the train conductor takes up the Nappanee to New York coupon of the ticket, sending it to the auditor of passenger receipts, while the passenger retains the larger portion of the ticket that is good on the foreign line for the remainder of his trip to Boston. This part of the ticket is taken up by the conductor on the last foreign line and forwarded to his auditor for final disposition.

AFTER the receipt of the Nappanee-New York coupon of the ticket by the auditor, it is checked against the report of the agent who issued the ticket at Nappanee. Then, along with others, the coupon is placed in a metal box for lodgment with the custodian of records. About two months usually elapse from the time the ticket is lifted until it is permanently filed away.

Under the regulations of the Interstate Commerce Commission, used tickets may be destroyed at the option of the carrier after completion of the audit, with some exceptions. The used local tickets, however, are held by the Baltimore and Ohio for a period of six months after the audit, and home interline and foreign interline tickets are held for a period of three years after the audit, as the tickets are needed for reference purposes. As to the exceptions to the rulings of the Interstate Commerce Commission, used caretakers' tickets must be kept for five years and redeemed tickets for three years. A macerating machine puts an end to the useful life of the railroad ticket. It is again to become pulp whence it came.

As interesting as the life of a railroad ticket are some of the operations in connection with its collection by the conductor and the accounting through the auditor's office. Cash fares collected



Conductor's punches "have a meaning all their own," and are changed frequently

by conductors from passengers who have not provided themselves with tickets beforehand are reported by the conductors on a special form. A separate report is also made of scrip coupons honored. The conductors forward these reports to the auditor, with a report of tickets "honored but not lifted," together with lifted tickets or coupons reading to destinations on their respective runs. This enables the auditor to keep a complete check of the earnings of the various passenger trains.

When cash fares are collected the conductors issue duplicate receipts, one to the passenger and the duplicate portion for the auditor. The cash so collected is deposited by the conductor with the agent at the end of his run. The agent issues a deposit receipt in triplicate, retaining the triplicate and giving the original and duplicate to the conductor who retains the duplicate for his record and forwards the original to the auditor, with cash fare report. This cash so given to the station agent is deposited by him with his other station receipts in a local bank, subject to the check of the railroad's treasurer.

USUALLY, at small stations, the ticket agent is also the freight agent. From an accounting and traffic standpoint, the agent's duties embrace ι comprehensive study of tariffs and :irculars to enable him to issue tickets ıt proper fares and over correct routes, ınd to be generally informed about 's railroad so that he can furnish in- rmation requested by the traveling ıblic. He keeps a stock record book to show all ticket stock received from the ticket supply clerk and enters in this book the forms and numbers of tickets sold at his agency each month. He also keeps a daily sales book and a daily cash book to show the value of the tickets sold as against the cash received and must maintain a balance between the ticket sales and the daily totals in the cash book, taking into account not only the cash received, but also the value of scrip tickets, prepaid orders, and United States Government transportation requests that are honored. He is required to keep his accounts in such condition, at all times, that the traveling auditor can satisfactorily check them when he pays his periodic visits to the agency.

After the conductor has examined and punched all tickets and coupons, local and inter-line, collecting those terminating on his run, he assembles his reports and arranges the tickets and coupons he has collected, separating coach from Pullman passengers for statistical and rating purposes, and puts them all in a large envelope addressed to the auditor. The envelope is then forwarded by "train mail."

These envelopes, filled with tickets, coupons, and so on, which have been collected, and the various reports of the conductors, are found each morning piled high on the mail table in the office of the auditor of passenger receipts. The mail clerk sorts the envelopes according to divisions of the road as represented by the territory covered by the run of each conductor.

The train earnings bureau next receives the envelopes, and from the contents the clerks "work" the revenue and earnings of each train by divisions. In this great mass of tickets and coupons has arrived the coupon of the ticket of the Nappanee-to-Boston passenger, which may be taken as an example of how all tickets and coupons are handled on the train earnings desks. Since the work of compiling train earnings and individual statistics is divided among the clerks on a divisional basis, the clerk receiving the coupon compiles the miles traveled and the revenue derived from this ticket for the Washington-New York distance only, because the miles traveled and the revenue accruing to each division between Nappanee and Washington have been compiled from the "honored but not lifted" reports of the initial and intermediate conductors.

After the train earnings clerks have completed their records, the local and home inter-line tickets are assorted into selling station order and filed in the ticket cases. At the end of each month these filed tickets are checked against the agents' ticket reports, and the fares, at which the tickets are reported, are checked against the authorized tariffs so as to insure proper accounting.

TICKETS issued by other railroads, known as "foreign inter-line tickets or coupons," are assorted by the names of the companies issuing them, being checked against the reports rendered by their respective companies. The proportions of the through inter-line fares are also audited to ascertain whether sufficient revenue has been received for the service given. The extensions and additions on the reports of the agents, as well as those appearing on the reports of foreign carriers are rapidly checked in a bureau equipped with modern calculating machines.

The home inter-line bureau supervises the apportionment of fares among various carriers that may have provided service in connection with a passenger. The passenger from Nappance to Boston has long since gone about his business, but that portion of his ticket fare from New York to Boston finds its way into the figures of the home inter-line bureau, where that portion is set up as a credit to the carrier that performed the service, and a subsequent report is made to the interested carrier.

The end of all tickets; they are macerated and headed for the paper mill whence they came. Destruction is by permission of the Inte

View of the front of the mercury boiler of the mercury vapor power unit at the South Meadow station at Hartford. Soot blowers, level gages, and the equalizer pipes connecting the mercury drums are shown

MERCURY VAPOR POWER TO THE FORE

VERY often some outstanding development will be announced, discussed widely for a time, will even be sensationalized much to the annoyance of the originator, and then, so far as the layman is concerned, it disappears from sight. If the development is meritorious, the silence is usually due to the fact that long years of experimentation are necessary to prove its full worth. The average man, however, does not realize this and is inclined to believe the worst.

This has been exactly the sequence of events in the case of the mercury vapor power generation scheme about which so little has been heard during recent years. This scheme has now proved not only commercially practicable but also, as the early discussions claimed it would be, more efficient than ordinary steam plants; and two new, and larger, mercury vapor units have been ordered. One of these is to be put into operation at the Schenectady plant of the General Electric Company and the other at the Kearny station of the Public Service Electric and Gas Company of New Jersey.

The mercury vapor process was invented by W. L. R. Emmett, of the General Electric Company nearly two decades ago. After preliminary experimentation, a trial equipment was built and operated in the Schenectady plant, from 1915 to 1917. In 1923, a combined mercury vapor and steam power unit was built for the Hartford Electric Light Company. This was the first mercury-vapor power installation in the world, and was described in the February, 1924, issue of SCIENTIFIC AMERICAN. The practical operating experience obtained with this first unit led to the construction of a 10,000-kilowatt mercury-vapor turbine, installed in 1930 in the South Meadow station of the Hartford company. The records of this installation show a substantial saving in fuel over usual steam generating equipment.

BRIEFLY stated, mercury offers decided advantages over water in turbine operation because it boils at a much higher temperature. The efficiency of any heat engine may be increased by increasing the temperature range through which it works.

One way to do this is to lower the temperature of the exhaust and a second way is to raise the temperature of the supplied steam. It is for the latter reason that steam turbines have been constructed to operate at higher temperatures and higher steam pressures. The minimum exhaust temperature is, of course, limited by the temperature of the available cooling water. The temperature of the supply is limited by the temperature of the combustion of the fuel, and in a steam engine is further limited by the properties of steam. At reasonably high temperatures, the pressure of steam becomes too great for convenient commercial operation.

The properties of mercury, however, are such that high temperatures can be obtained without high pressure. For example, mercury vapor at a temperature of 958 degrees, Fahrenheit, has a pressure of 125 pounds gage while steam at a temperature of only 569 degrees, Fahrenheit, has a pressure of 1200 pounds gage.

Mercury is boiled and vaporized over a fire just as water is boiled and vaporized in a steam boiler. This mercury vapor then drives a mercury turbine, just as steam drives a steam turbine in an ordinary system. At the exhaust end of this turbine the mercury vapor is still hot enough to boil water and make steam at pressures which are in common use. Therefore, instead of circulating cooling water through the mercury condenser as in the ordinary steam condenser, a level of water is held in the condenser just as in a steam boiler. The water boils and makes steam. A large part of the power generated from the mercury turbine is obtained at very high efficiency since

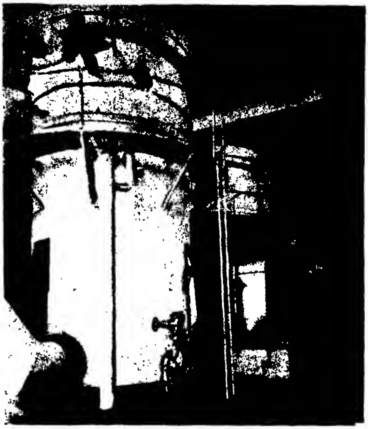
the heat in the exhaust is not lost but is used in the steam production. Thus the mercury takes up heat from the fire and delivers it as work to the mercury-vapor turbine and also as heat to the water in the mercury condenser.

In view of the announcement of the two large mercury-vapor turbine-generators which will be installed in Schenectady and in New Jersey, the following data regarding the performance of the Hartford turbine in 1930 is of interest. The Hartford unit has been in continuous operation since February 4, 1930, except for occasional weekends and during nine days in May of that year when minor changes were made. The ease in starting and operating the apparatus, and the lack of appreciable vibration and noise of the 10,000-kilowatt mercury turbine, is apparent. During the nine months from February to October, inclusive, the performance of the unit was as follows:

Coal burned	69,187,548 lbs.
Water evaporated	572,415,000 lbs.
Output mercury turbine . .	42,297,060 kw-hr.
Equivalent output from steam	56,918,660 kw-hr.
Total station service . . .	1,924,390 kw-hr.
Total net output	97,282,270 kw-hr.
Coal rate on total net output	0.712 lb. kw-hr.
Hours in service	5,030

The ease in operating this apparatus was fully demonstrated in 1930, and experience during the year indicated that maintenance costs will be less than with standard steam plants. Low fuel consumption was obtained consistently over the entire nine months, as shown by the month-by-month figures and by the figure of .712 pounds of coal per kilowatt hour for the entire period as noted in the table above.

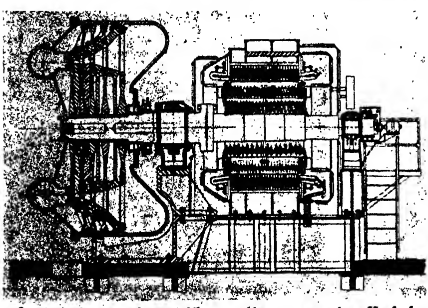
No data are available on the New Jersey mercury boiler and turbine plant except that it is to have a rating of 20,000 kilowatts and will be ready for use in the fall of 1932. The 20,000-kilowatt mercury-vapor turbine generator which is to be installed in Schenectady in a new power plant, however, will be outstanding in several respects, it has been announced by Burton L. Delack, manager of the Schenectady Works of the General Electric Company. It will be the first outdoor plant of its kind; and it will be the first plant ever to have co-ordinated industrial requirements and utility sources of power. The mercury-vapor turbine will be twice as large as the Schenectady-built unit in service at the South Meadow station and, because of increased pressure and temperature of operation, it will be even more efficient than the Hartford installation, which itself is so much more efficient than regular steam generating stations.

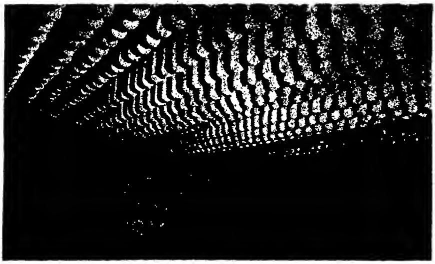

Hartford 10,000 kilowatt unit, showing end of generator and the mercury vapor condensers. The boiler is shown on opposite page

The new generating station, which will be leased and operated by the New York Power and Light Corporation, will supply electricity for the power company's transmission system and steam for use in the General Electric factory. The 4,000,000-dollar development will be located on General Electric Company property, on land recently made available for development when a city road was moved from within the property to the bank of the Mohawk River.

ONE of the present steam generating plants of the General Electric Company, near the front end of the plant, will no longer be used—its 20 old boilers will be dismantled. Steam for the operation of the non-condensing steam turbine in the building will be supplied from the new power station, being conveyed there in pipes in a re-enforced concrete tunnel more than three fifths of a mile long. The other generating station within the General Electric works, which will be connected with the new station by a tunnel a few hundred feet long, will be retained for some years to come.

In addition to the 20,000-kilowatt mercury boiler and turbine, the new outdoor station will include a steam


Longitudinal section of 10,000 kilowatt turbine-generator unit at Hartford. The mercury turbine has five stages, and the speed is 720 revolutions per minute



The high cost of mercury necessitates a suspended tube boiler design that will give a maximum amount of heating surface with a minimum quantity of mercury

The 1923 installation of the mercury vapor process unit at the Hartford light company's plant

boiler to supply 300,000 pounds of steam per hour, in addition to the by-product output of 330,000 ponnds per hour from the mercury condenser, for process, heating, and testing steam in the General Electric works. Adjacent to the power station site is the substation, through which the electric energy from the mercury turbine is supplied to the 110,000-volt transmission system of the power company. It is through this substation, too, that the electricity for the factory is supplied by the power company at 13,800 volts, the voltage at which the mercury turbine-generator will operate.

The mercury required in the boiler will weigh a quarter of a million pounds—but so heavy is this liquid metal that such a weight occupies a cubical space less than seven feet on a side.

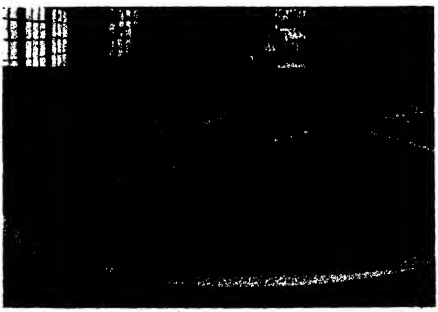
For the Schenectady installation, the mercury boiler drums will be longer than those of the 10,000-kilowatt equipment at Hartford, but the furnace width will be no greater. The design of the unit was based on generating 20,000 kilowatts from the mercury turbine and 240,000 pounds of steam per hour made by condensing mercury (the additional 90,000 pounds of the 330,000 pounds already referred to is obtained from the water walls referred to below). The doubling of the Hartford capacity will be obtained by increasing the mercury pressure to 125 ponnds gage and by installing a mercury heating surface on the upper portion of the furnace walls. By thus protecting the furnace walls, the heat liberated in the furnace can be greatly increased over that at Hartford, where the furnace walls are air-cooled. Moreover, the combustion air can be preheated to a higher temperature than was considered desirable with the Hartford furnace. Therefore, a low flue-gas temperature to the stack can be obtained without the use of a water economizer. This will permit a greater application of regenerative feed heating with the steam cycle in case condensing steam turbines are used for generating power.

This 20,000-kilowatt apparatus can be installed in a space no greater than that needed for the 10,000-kilowatt equipment at Hartford.

WHEN pulverized fuel is burned, the lower portion of the furnace walls will, for the present, be protected by water heating surfaces. The fuel economy will be somewhat impaired with this arrangement of furnace as additional fuel is needed to generate steam directly in the furnace walls. Further experience is needed before the entire furnace walls can be protected with mercury heating surfaces.

With a load of 20,000 kilowatts on the mercury turbine and with the power developed from the 240,000 pounds of steam generated at 400 pounds pressure and 350 degrees, Fahrenheit, by condensing the mercury vapor, the expected fuel rate will be 8800 B.t.u. per net kilowatt-hour. With water cooling in the lower part of the furnace, the fuel rate will be from 9100 to 9500.

The design and erection of the new Schenectady plant are being handled by the Construction Engineering Department of the General Electric Company, of which A. R. Smith is in charge, with engineers of Stone and Webster and of the New York Power and Light Corporation in advisory capacity.



Another part of the 1923 installation: the mercury boiler interior. These tubes, filled with mercury at an equalized level, project downward into the fire box

AUSTRALIA'S GREAT METEORITE

By CHARLES P. OLIVIER

Director, Flower Observatory of the University of Pennsylvania; President of the American Meteor Society; Author of "Meteors," "Comets"

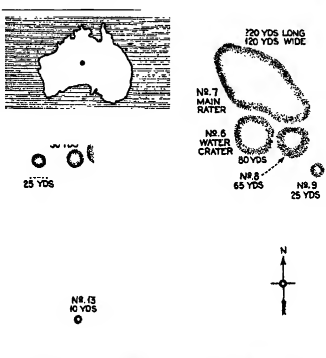
READERS of the SCIENTIFIC AMERICAN have had the opportunity in recent years to see several articles which dealt in considerable detail with the famous Meteor Crater in Arizona, and the more recent Siberian fall of 1908. A few smaller craters, more or less certainly identified as due to impact, have been announced in various publications. But only in the past few weeks has the news spread that in Australia was to be found a group c which will rank in size next to that in Arizona. Thanks to one of the members of the American Meteor Society, Mr. R. C. Shinkfield of Adelaide, the writer has received detailed and presumably authentic information about this new discovery.

THE craters are 13 in number and are scattered over an area one half mile on a side. They are seven miles west-south-west of Henbury, on the Finke River in Central Australia, and are locally known as the "Double Punch Bowl." The position is in longitude 133° 15′ East and latitude 24° 30′ South. All but the largest are approximately circular, but of dimensions about 220 by 120 yards. The others are approximately: one 10 yards in diameter, one 15, two 20, three 25, one 30, two 45, one 65 and one 80. The latter two are almost in contact with the largest, which is the north-easternmost of the whole group. Their proximity has perhaps modified its original shape, as the masses forming them may have fallen some seconds later than the largest mass which formed it.

The craters evidently were made a long time ago, as the walls have washed down and the interiors are largely filled. Indeed the largest crater is now only 50 feet deep. On the outside their rims have slight elevations and very gentle slopes. Within they are covered with coarse grass and other vegetation of the region.

From their distribution the writer infers that the original masses came from the south-west, the larger ones going farthest. From what has been said, their age makes them less spectacular than if they had been due to a recent impact. That they must have been formed long ago is borne out by the fact that the natives have no legends nor stories about them.

They were first announced by a prospector, J. M. Mitchell, who wrote to Professor Grant Kerr of the University of Adelaide concerning them. He sent a meteoric mass to substantiate his deductions. This was in January of the present year. In May, A. R. Alderman and F. L. Winzow, both lecturers in the University, were sent to investigate, and the details here given are from their report. They located about 800 meteoric fragments, which were mostly found on the western sides of the craters. They are quoted as being of the opinion that this indicated that the objects came from the east. The writer, on the slender evidence at hand, believes that it came from the south-west, as already mentioned. Many of the smaller fragments have been completely oxidized and have disintegrated into iron oxide. It is stated that pieces of melted sandstone were picked up. In several of the craters there were low ridges of rock radiating from the edges. The idea expressed was that the force of impact drove the surrounding rock upward, along these ridges. This phenomenon has not been reported elsewhere.



of meteor craters in Australia. *Insert:* Location of the group

This group evidently represents an intermediate type between the Arizona and Siberian falls. The first must have been due to a very compact group of immense size and mass; the second to a dispersed group of perhaps 150 individuals each big enough ake a recognizable hole. The Australian fall, however, contained at least one single mass or very compact group, which was capable of making a crater of considerable size, while the smallest one is qui parable to the largest those in Siberia.

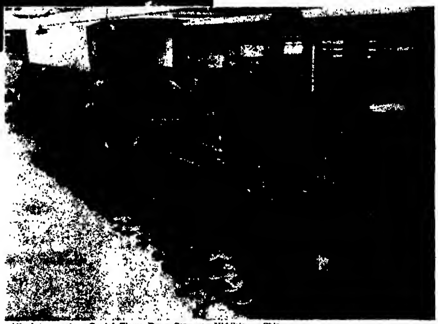
WE may well presume that all craters up to ten feet in diameter, in Australia, would by now have been obliterated by erosion, while in Siberia, as they were found only 20 years after formation, even the small ones could still be recognized. Geologically speaking, however, even the Australian fall is recent. Hence we may no longer consider such catastrophes many other cases will be recognized as the less well explored territories of the earth are better known. Such discoveries give a constantly increasing interest to all studies of meteoric and cometary bodies, the two kinds which can actually reach the earth's surface without being formed on it.

Petitions have been presented to declare the area a public reserve, under the Australian Federal Government, in order to prevent unauthorized spoliation. It is hoped that this will be done, as the craters are of great scientific interest and should be protected in every way. Meantime, everyone interested in science will await with impatience a complete survey and study of this new discovery in Central Australia.

When further facts become available these will be published.
—THE EDITOR

PAPER'S THINNEST WEB

By H. W. VOGLER



All photos courtesy Crystal Tissue Paper Company, Middletown, Ohio

Upper left: Pulp is fed into the beater where it is mixed with water, bleached, and beaten until the fibers are made ready for paper machine. *Above:* The "wet end" of paper machine where the fibers are consolidated, forming a web

THE process of making tissue paper really begins in the selection of the trees from which the paper pulp is made—a selection which is of the highest importance in determining the characteristics of the finished paper. Cellulose fibers are found in all trees, but fibers from different trees differ somewhat in their nature. The most satisfactory fibers for tissue paper come from the sturdy spruce trees. Spruce contains a larger percentage of cellulose than most woods and the fibers are longer, more flexible, and stronger. Saws cut up the logs into two-foot lengths. The bark contains no cellulose fibers and is therefore stripped off.

BROADLY speaking there are two pulping processes—chemical and mechanical. Sulfite, sulfate, and soda pulp are made by the chemical process; groundwood by the mechanical. If we were to visit a groundwood mill, we would see the logs being torn to pieces by pressure against a huge grindstone. The grinding, with the aid of a constant flow of water, reduces the wood to a pulpy mass. Afterwards, the watery pulp is screened to remove slivers, knots, and other impurities, the water is squeezed out, and the pulp is cut into squares and folded into laps for shipment. Groundwood is the lowest class of pulp made and it is, therefore, used in only the cheaper grades of tissue that are used for stuffing purposes. Groundwood contains only about 55 percent cellulose and the fibers are so short and stiff that they do not "felt" or interlace properly.

In a chemical pulp mill the two-foot lengths of log are torn into chips on a machine consisting of a massive iron disk with steel knives projecting from its surface. As the disk revolves, the logs are applied to its surface and small chips fly off. There are also a number of high iron tanks called digesters into which the flakes of wood are charged. Cooking liquor is added, which, in the sulfite process, consists of bisulfite of lime, made by combining sulfur dioxide gas with water and lime. The digester is then closed tightly, the temperature is raised to from 325 to 365 degrees, and steam pressure of from 70 to 80 pounds per square inch is applied. Thus the wood is thoroughly cooked until the acid combines with the ligneous materials, leaving the cellulose fibers free for paper making.

It takes about eight hours to complete a "cook" by the direct or quick-cook method, or from 24 to 28 hours by the slow-cook or Mitscherlich process. Then the outlet at the bottom of the digester is opened and the steam pressure forces the material into a large bin with a screen bottom through which the liquid drains off. There the pulp is washed for several hours to remove the dissolved lignins after which careful screening removes all impurities, leaving the fine cellulose fibers. These are dried, matted together in sheets and packed in bales or rolls for shipment to the paper mill.

If we start at the beginning of the papermaking process, the first thing we see is the beater room. Here the minute fibers are cut short or flattened out or frayed in whatever manner is dictated by the requirements of the sheet that is to be made. There is an old saying among paper makers that "paper is *made* in the beaters," which means that here the fibers are so manipulated as to produce the characteristics desired in the finished sheet.

A beater is a big oval tub, divided lengthwise by a partition called the "mid-feather" which stops short of both ends, thus making a channel all around the beater. Across this channel, between the mid-feather and one of the side

walls of the beater is a large roll set with knives, covered by a hood.

The pulp remains in the beater for hours, slowly circulating around and around. Then, after it has been beaten sufficiently and bleached, washed, dyed, and sized, a valve is opened and it is allowed to drop down into a storage chest. Here a big revolving paddle wheel keeps it constantly agitated until the paper machine is ready for it. The pulp is subsequently put through a Jordan engine, where the beating process is carried further.

The paper machine, that massive series of wires, felts, and drums on which the web of tissue is actually formed and dried, holds the center of the stage in the machine room. The first thing we see on the paper machine is the vat, and if we look down upon the thin swirling liquid it contains, we marvel at the thought that out of it can be drawn a sheet of tissue paper. By the time the stock reaches the vat, enough water has been added so that only 0.2 percent of the solution is fiber.

There are two ways of forming a sheet of tissue from the solution in the vat. That is to say, there are two types of paper machine—cylinder and Fourdrinier. In the Fourdrinier machine, there is a fine wire screen in the form of an endless belt. A continuous uniform stream of stock flows from the vat to the endless wire screen, over a rubber cloth or apron. The size of the stream is regulated by a gate called the "slice." The Fourdrinier screen is out in the open and we can easily see the water drain out of the paper. It is helped along by a series of little brass "table" rolls over which the wire moves, and by several suction boxes. We may wonder, as we watch the Fourdrinier, why the entire frame on which the wire moves is roughly vibrated back and forth, just at the point where the stock flows to it. This shaking arrangement is decidedly important. It helps cross the fibers, reducing very materially the grain of the sheet.

The Fourdrinier has a so-called "couch roll." We see it just at the point where the endless wire belt begins its return journey. An endless web of felt passes around the couch roll and the paper adheres to it in preference to the wire. This felt carries the paper through two smoothing rolls called presses to a denser top felt which carries it to the driers. As we follow the paper to the driers, we see a long series of revolving steel drums arranged in two tiers on a frame. These are filled with steam and as the paper passes around each of them, some of the water is evaporated. By the time the paper reaches the end of the series, it is perfectly dry. The paper passes over the top of one drier and then around the bottom of the next and this brings both sides of the sheet alternately in contact with the drying surface.

At the end of the driers we see the endless sheet of paper passing back and forth several times between a stack of heavy steel rolls. These are the calenders which iron out the sheet, giving it a smooth even surface. It is then wound on a large spindle called the reel.

There are two reels at the end of the machine so that when one is full, the web of paper can be transferred to the other. The paper on the first reel is then rewound into rolls. Up to this point, the paper extends across the entire width of the machine, but in rewinding it passes between sets of circular slitter knives which slit the sheet into its proper width.

THUS is tissue paper made, but before it can be used for packing fine gowns or for wrapping dainty gifts, it must be converted from rolls into sheets. Let us visit the finishing room and see how this is accomplished.

There we see a huge frame, on which are mounted 24 "jumbo" rolls of tissue. Unwinding from these rolls are 24 continuous webs of tissue all of which run simultaneously through sets of slitter knives which trim the edges and cut the paper to the proper widths. As they proceed a little farther, we see them clipped off to the proper lengths by a heavy knife set in the face of a revolving drum. As the 24 sheets proceed, a steel arm comes down, forcing the entire quire between a set of rolls which folds it. Twenty 24 sheet quires make a ream; each ream is wrapped and ten reams are packed in a bundle. If the tissue is to be sold at retail for use the home, it is wrapped on tubes.

Of course, there are many uses for tissue other than for wrapping. Much of it is shipped out of the mill in machine rolls for converting into other products. Household waxed paper, for example, is all made from tissue. So are the so-called "fiber" rugs so widely used for porches and summer homes. There are literally hundreds of other places where tissue is used.

Above: The paper is formed from the fibrous material into web of paper which is dried so as orm a continuous moving strip which can be spooled and cut. *Right:* Girls putting up tissue in rolls for holiday trade

WHERE NOT TO LOOK FOR OIL AND GAS*

By DR. CAREY CRONEIS

Assistant Professor of Invertebrate Paleontology at the University of Chicago; Geologist, Illinois State Geological Survey

IN spite of the seeming deluge of oil, many a disillusioned prospector will tell you that "oil and gas, like gold, are where you find them." So they are—but through the intelligence of man in general and of engineers and geologists in particular, and, I must confess, through sad experience as well, we have learned that they are almost invariably found in *certain* places. Where are these certain places?

A study of a map of the world's oil resources (Figure 2) reveals the fact that the great oil producing areas, although widely scattered, are limited to rather definite zones, and that very large sections of the face of the earth are entirely without oil reserves. Let us now examine a map of the world (Figure 4) designed to show, first, the plateau of ancient rocks; second, the lowlands of ancient rocks; third, the great folded mountain ranges; and fourth, the lowlands of younger rocks. If we have kept in mind the distribution of the world's great oil fields we are struck by the fact that none of them is located either on the plateau or the lowlands of ancient rocks, and equally apparent becomes the still more significant fact that oil and gas *are found either along the great mountain chains or in the lowlands of recent rocks which border those chains.*

SUCH a world-wide alinement can hardly be coincidental. Thus there seems to be a fundamental relationship between mountain building and the distribution of oil and gas.

To appreciate fully the real significance of this relationship we must inquire somewhat further, if briefly, into the origin, migration, and accumulation of oil and gas.

The question of the mode of origin of oil and gas has engaged the attention of scientists for more than a century, but it has not yet been surely answered. The theory that they have originated from the chemical combination of natural inorganic substances has been advocated mainly by chemists, and is based chiefly upon laboratory experiments. It is possible to form hydrocarbons through inorganic agencies, and the theory cannot summarily be dismissed; but geologists, for a number of reasons which cannot be entered into here, find the large quantities of petroleum and natural gas in sedimentary rocks incompatible with such a mode of origin.

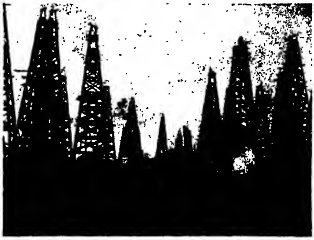
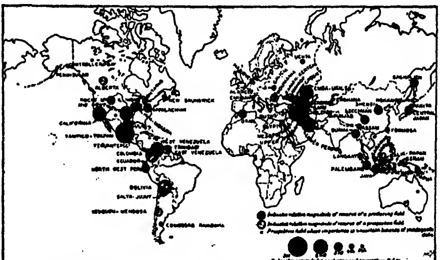


Figure 1: Cause of our deluge of oil: overdrilling

Nearly all geologists are now convinced that oil and gas are of organic origin.[1] They believe that natural hydrocarbons have been formed by the decomposition of organic material deposited with the sediments. As to whether the organic material consisted of plant or of animal remains, or of both, there are still several different opinions. It is clear, however, that under certain conditions the natural decomposition of the remains of either or both animals and plants (Figure 3) *may* supply the hydrocarbons found in oil and gas. It therefore seems reasonable to suppose that some oils are solely of animal origin, that others were derived from plant remains alone, and that many have originated from a combination of the two.

Although we now know that both oil and gas may migrate relatively great distances from their place of origin, nevertheless if they have formed in the manner geologists believe, then the position of oil and gas pools today must in some measure be influenced by the sites of deposition of the animal and plant remains from which the oil and gas were derived. Marine life is most prolific along the strand, and in shallow waters, that is, down to depths to which sunlight penetrates. It also happens that organisms living in such a habitat are at their death subject to burial with the sediments which are constantly being washed into the sea in such positions. In other words, the sites of abundant marine life and conspicuous marine deposition are in most

[1] See H. Ries, "The Origin of Petroleum." *Scientific American* January 1939, pages 56-59. —*Editor.*



After Thom, Petroleum and Coal

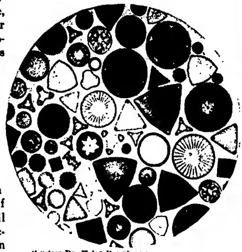
Figure 2: World petroleum resources. These occur in definite regions

*Extracted from the *Journal of the Western Society of Engineers* (Chicago)

cases the same. Hence along ancient shores the muds that were washed out to sea buried either organic material, later to be converted to petroleum, or globules of oil which were already formed as a result of a special type of putrefaction carried on under the influence of marine waters. In either case, and here I am passing roughshod over many of the most difficult of the petroleum geologist's questions, the shales formed from the compacting of these muds are regarded as the most important "source beds" for oil and gas. Thus it becomes apparent that the geologist is supremely interested in ancient shore lines, for their position in large part determines the location of the original source rocks.

But what, you may well ask, do ancient strands and sites of deposition have to do with the present location of mountain chains and the position of oil and gas pools? The answer is that practically all of the great folded mountain ranges now stand where sediments formerly were being laid down.

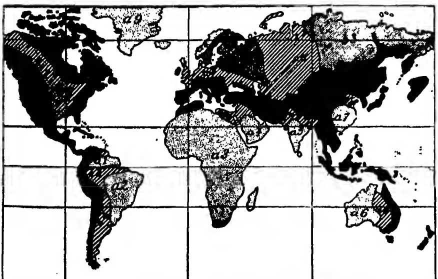
This important change in the earth's facial expression has come about in the following fashion: Sites of deposition in the past, at least so far as the sites were located on what are now the continental masses, commonly were shallow marine basins bordered by relatively high lands composed of older rocks. As erosion slowly wore down the borderlands the materials carried to the basin tended to fill it up. With added weight of sediments, however, the basin of deposition, commonly called a geosyncline, gradually sank. Thus more and more material was constantly added to a progressively sinking trough. But as a consequence of the slow sinking, the type of sediments deposited remained, throughout the vast thicknesses of accumulated material, essentially of the shallow-water type. Because of this permanency of relatively shallow waters, geosynclinal seas of the clearer type usually teemed with both plant and animal life.



Courtesy Dr Heinz Rosenberger
Figure 3: Diatoms, microscopic plants, one probable oil source

As a further and more important result of the predominately shallow-water type of deposition, these geosynclinal areas have gradually become lines of weakness in the earth's crust. Thus it has happened again and again that "mountains have grown out of geosynclines" (Figure 5). In other words, because of the earth's inherent tendency to resist accumulative stresses for considerable lengths of time, zones of deposition, notably weaker than the bordering highlands, continue as such in some cases for geologic periods. When the gathering forces tending toward contraction of the earth's surface reach such a strength that they can no longer be withstood by the sediments in the geosynclinal area, then the older and stronger rocks which bound the basin move toward each other. As a result the softer rocks between are caught as in the jaws of a gigantic vise, and gradually they are folded and squeezed until the surface of the earth there has been notably foreshortened. Thus do the areas of sedimentation become complexly folded and faulted tracts; and where deposition was formerly dominant, erosion now plays the leading rôle.

All of the long and complicated steps by which basins of deposition are formed and by which mountains finally grow out of them have also played their part in the migration and accumulation of oil and gas (Figure 6). In the early stages of the formation of these products they are both widely disseminated through the sediments containing the animal and plant material from which they were derived. They are then gradually gathered together by many forces among which may be mentioned capillary attraction, displacement, gravitation, gas pressure, differences in specific gravity, and the general circulation of



Courtesy the Institute of Petroleum Technologists (London). After Stamp
Figure 4: Main geologic units of the world. Plateaus consisting mainly of the ancient metamorphic rocks, most of which do not contain oil, are marked *a*; a_1 being the Guiana highlands, a_2 Brazilian Plateau, a_3 African plateau, a_4 Arabian plateau, a_5 Indian plateau, a_6 Western Australian plateau, a_7 South China, a_8 Scandinavian highlands, a_9 Greenland. Units marked *b* are lowlands of ancient rocks, which are also non-petroliferous: b_1 the Laurentian shield, b_2 Baltic shield and Russian platform, b_3 "Angaraland." Those marked *c* are lowlands of younger rocks which *may* contain oil; c_1 being the central plains of North America, c_2 Orinoco basin, c_3 Amazon basin, c_4 Argentine, c_5 North European plain, c_6 West Siberian lowland, c_7 plain of Hindustan, c_8 North China plain, c_9 Australian lowlands, c_{10} Egypt-Iraq. Finally, the black units are the mountainous regions on whose flanks oil fields tend to be concentrated

CAPILLARITY, which moves a liquid in all directions through small openings in a solid, moves petroleum through minute pores in rocks much as kerosene rises in a lamp wick. Displacement, an effective cause of the migration of oil and gas, may result from the compacting of the beds in which those materials occur, due to the weight of the overlying rocks. The muds in which oil and gas are assumed to originate are much more compacted than are the associated sands into which the hydrocarbons are driven. The progressive cementation of the pore spaces in these sandstones in turn may cause further migration of the oil and gas, and thus constitute another type of displacement.

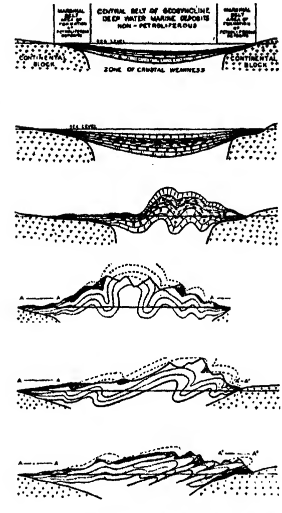
Gravitation is rarely an important agent in the migration of oil and gas, and it is effective only where the sands are both porous and free from water. Gas pressure, however, has been effective in the movement of hydrocarbons. The expansion of the gas equally in all

directions as it is formed not only pushes it through the openings in the rock, but tends also to move any liquids present ahead of it. The differences in the specific gravities of oil, gas, and water is a further cause of migration of hydrocarbons, for, as the oil and gas are lighter than water, they are carried ahead of the water in its movement. The general circulation of water has also contributed to the migration of oil and gas, particularly in the early stages of their n

THE place of final accumulation of oil and gas after their migration depends largely upon the structure of the beds containing them. This structure in turn is in most cases the result of the mountain building I have just described; in all cases it is the result of movements of one sort or another in the earth's crust. Oil and gas move along tilted and porous beds. In the comparatively rare dry porous beds, the oil moves downward and is concentrated in the synclines, or downward bent strata. If the beds are saturated with water, as they generally are, the oil and gas are driven upward by the water. This upward migration may continue to the surface, wher

r it may be stopped in one or more of several ways. If the reservoir bed is lenticular and the lens is overlain by impervious strata, the oil and gas cannot move upward; if the reservoir is sealed by a fault, or by an intrusive mass, or by an asphaltic residue at the surface, these also prevent the escape of the oil and gas. But the most effective, and by far the most common, obstacle to the continued upward migration of oil and gas is a marked reversal or diminution of the dip of the reservoir bed (Figure 7). In such cases the hydrocarbons rise to the highest part of the structure, but further movement is prevented by an impervious layer which overlies the reservoir.

The more desirable of these latter structures are particularly common along the flanks of the great folded ranges where the movement has not been sufficiently severe to fault the reservoir complexly. In these anticlinal structures of large size considerable gas pressure is developed, and upon drilling such a structure the oil may be driven upward by the expanding gas to form a flowing well, or "gusher." The commonly amounts to 500



Courtesy Journal of the Institution of Petroleum Technologists

Figure 5: **The upper three diagrams illustrate the deposition of sediment and the formation of geosynclinal mountain ranges. The lower three are the main types of folded mountain belts. Oil fields are likely to occur in the regions marked A—A, but in the areas marked A′—A′ they are deeply buried**

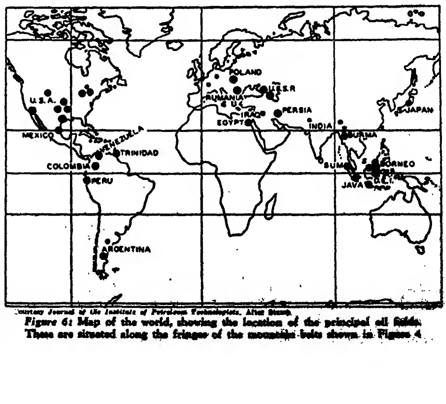
pounds per square inch, and in many cases it is higher.

So far we have been engaged in getting a bird's-eye view of the importance, properties, origin, migration, accumulation, and production of oil and gas; and we must now inquire as to how the geologist goes about finding those products. Is there anything mysterious in his methods? Does he, as many seem to think, practice some scientific hocus-pocus or legerdemain? Is he after all only a "water witch" gone to college?

MY experience with the qualified oil geologist leads me to come to his defense. He is usually thoroughly trained in theory, made wise by practice; he is conservatively optimistic, but expects no miracles; he is willing to pioneer, but unwilling to spend too much of his company's money in following up his own pet theories. He knows that good hard work in the field is better than uncontrolled speculation in the office. Field work completed, he is not above philosophical mental excursions whose results in many .e miraculous.

Geologist by name, he is s times a chemist, often a physi cist, and always an engineer. In short, trained as a geologist, he employs all of the sciences, yet spurns not common sense.

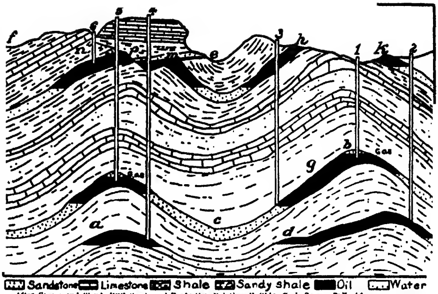
Such an oil geologist, and there are many of them, in going into a new area invariably



Courtesy Journal of the Institute of Petroleum Technologists. After Stamp.

Figure 6: **Map of the world, showing the location of the principal oil fields. These are situated along the fringes of the mountain belts shown in Figure 4**

asks himself a number of questions somewhat as follows: Are there surface indications of oil or gas, such as seeps? Are the rocks of sedimentary origin? Are the rocks, to be encountered by the drill, of the same age as those in some producing field? Is there a probable or possible source of oil and gas? Are porous beds present? If so, do they have a sufficient impervious cover? Is the structure suitable to the accumulation of oil and gas? Are the beds so slightly metamorphosed by heat and pressure that oil and gas, if once present, have not been driven off? And so on. An affirmative answer to all of these questions, except the first, is regarded as very desirable before drilling in the area is undertaken. Time does not suffice to explain how the geologist answers all of these and other questions, but several of the procedures which he has developed for their solution may prove of interest.



After George and Cloud, "Oil Sands and Production Relations," Okla. Geol. Survey Bull. 43

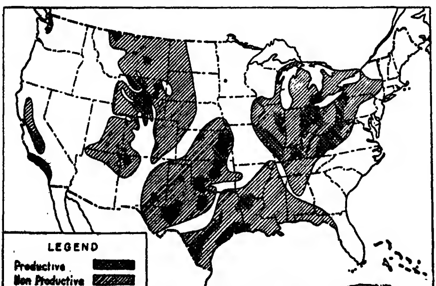
***Figure 7:* Sketch illustrating numerous structural features and showing the position and relation of oil, gas, and water to synclines and anticlines. *a* and *b* are anticlines; c and *f* are synclines; *d* is a terrace; *e* an oil seep on a syncline; *g* indicates greater accumulation of oil (black) on the closed side of a structure; *h* and *k* are outcrops of oil-bearing rock, sealed by a deposit of paraffin or asphalt; *e-n* is an unconformity; *m* shows migration of oil from older to younger porous rock. At *p* an impervious stratum seals in the oil. Well No. 1 produced gas and oil; No. 2 produced a *little* oil, then water; No. 3 struck the edge of the water; No. 4 gave a small production, also water from three sandstone strata; No. 5 gave a good production from two sands and would produce from a third if deepened; No. 6 produced from the first sand**

THE degree of rock metamorphism may be determined by several methods, but the most widely used criterion is the carbon ratio of the coal in the area examined. In 1915 David White advanced the theory that the percentage of fixed carbon in pure coal is an accurate index of the degree of metamorphism of the rocks containing the coal, and that the general prospect of obtaining oil in an area in which coal occurs may therefore be determined by a study of the carbon ratios of the coals of that area.

After studying the locations of Appalachian oil fields in connection with the carbon ratios of the coals in them, White concluded that oil in commercial quantities would not be found where the carbon ratios of the coals were higher than 65. In other words, as one moves from the gently folded Appalachians on the west toward the more intensely folded rocks on the east, he finds the coals increasing in their fixed carbon content. He notices also that beyond a certain line no more oil fields occur. Further carbon ratio studies elsewhere in North America, and on other continents, in the main have seemed to justify White's conclusions, and they led him to add that the degree of regional metamorphism in any area determines also the character of oil it contains. Although the entire validity of this theory recently has been questioned by some geologists, most workers regard it as a useful empirical generalization of especial value in ruling out certain areas in which, although otherwise attractive, the drilling hazards are made unduly great by the regional metamorphism.

Another example of the geologist's utilization of scientific methods is his development of geophysical means of locating structures in areas in which the bedrock is concealed. These methods, to the uninitiated, do seem to partake of witchcraft. In the main they are based on (1) differences in the reaction of petroleum, salt water, and different types of strata to the transmission of radio waves, (2) differences in the electrical conductivity of different substances found in the prospective area, (3) differences in the magnetic qualities of different types of rocks, and (4) differences in the density of the different types of material found in the earth's crust as determined by a torsion balance or by the seismograph.

As a result of this last method and other types of detailed exploration over most of North America, it has been possible to pool the data thus accumulated and to point out "petrolific provinces" (Figure 8). That is, as a result of information gathered by independent geologists, oil companies, and by state and federal geological surveys, those areas in which there is some chance for oil and gas have been rather definitely outlined and set apart from those regions in which it is essentially hopeless to prospect further.



After Emmons, "The Geology of Petroleum and Natural Gas" (Van Nostrand Co.)

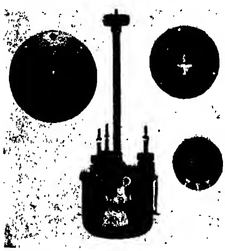
***Figure 8:* Petrolific provinces of the United States. The five shaded areas are, from left to right, the Pacific, Rocky Mountain, Mid-Continent, Gulf, and Eastern provinces. Note that only parts of the several areas are producing oil**

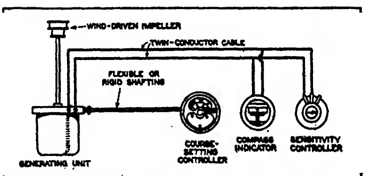
ELECTRICAL AIDS TO BLIND FLYING

By PROF. ALEXANDER KLEMIN

THE human being with normal senses can fly very successfully in fair weather, although he has the unusual problem of governing his craft around three axes. Flying "blind," as in fog, he is baffled. Man is accustomed to one accelerating force—gravity—which always acts vertically downwards. Aloft he is subjected to much larger forces which may act in any or all of three directions. A spin so disturbs the internal fluid of the ear that the pilot may think spinning still persists long after it has ceased. In a fog, he may imagine his craft to be flying level and straight ahead, when his plane is in reality in a spin. Once the horizon disappears he is truly helpless.

Pilots who once argued for the reliability of their senses are now firmly convinced that instruments are essential. Instruction in blind flying, with covered cockpits, is becoming general. (See page 528, December, 1929, page 470, June, 1930, and page 430, December, 1930 SCIENTIFIC AMERICAN.) Complete instrumentation for blind flying is being achieved.





Upper left: The new magneto compass generating unit, controller, indicator, and potentiometer. *Upper right:* Interior of magneto generating unit, showing course-setting control. *Drawing:* Diagram of connections of units of the magneto compass

WHILE at the end of the 19th Century, applied science and engineering had got fully into their stride, invention was still largely a matter of individual effort or the result of effort by small groups. It is true that entirely original developments in applied science are still likely to be achieved by brilliant individuals, but the solution of technological problems which are clearly indicated by the requirements of an industry is far more apt to lie in the hands of a well organized industrial group.

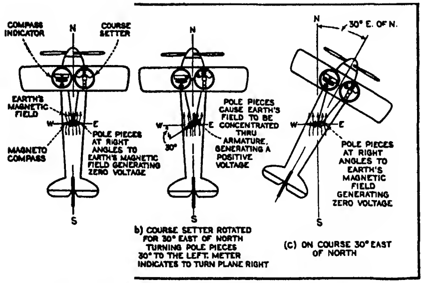
The General Electric Company, in its research and engineering departments, provides perhaps the ideal group for industrial research. Laboratories of every description, supported by full facilities for experimental construction, specialists in every branch of applied science, and executives who recognize the value of research and invention and support experimentation to the limit without too great an anxiety regarding immediate profits, provide an ideal set up.

When, with the growth of air transport, the problem of complete instrumentation in flying became of importance, the General Electric Company found an excellent opportunity for its splendid research organization. While government bureaus, other industrial organizations, and the universities have all contributed to the problems of blind flying, it is remarkable how nearly the instruments of this company cover the entire field of blind flying.

The General Electric "magneto compass," a rival of the "earth inductor compass," has given the airman an instrument far superior to the ordinary compass. The magneto compass is expensive, relatively heavy and not simple, but its application in aerial navigation is more than justified. It consists essentially of a generating unit, a remote-indicating instrument, and a course-setting mechanism. The generating unit is mounted in some part of the airplane relatively free from disturbing magnetic influences, such as "aft" in the fuselage near the tail assembly. It is located inside the fuselage with the drive shaft extending outside so that the wind-driven impeller is turned by the relative air velocity in flight, thus driving the generator. The other component elements which are unaffected by local magnetic disturbances are mounted on the instrument board in the pilot's cockpit.

THE magneto compass generating unit operates just like a direct-current generator. It has an armature and a commutator but uses the horizontal component of the earth's magnetic field as its field of force. Pole pieces of Permalloy serve to concentrate the magnetic lines of force because they prefer to pass through the alloy rather than through the adjacent air spaces. When the pole pieces lie parallel with the earth's lines of force, that is, magnetic north and south, the generator field strength is maximum, causing a maximum generated voltage. When

the pole pieces are at right angles to the earth's field, that is, magnetic east and west, the generated voltage is zero. Thus, with the pole pieces pointing east and west, the indicating instrument pointer is on zero in the center of the scale, above the nose of the miniature airplane which remains stationary. A swing of the pole pieces from the east-west position picks up some of the earth's field and causes the generator to generate "positive" for one direction and "negative" for the other. A corresponding movement on the indicating instrument shows that the airplane has turned to left or right of the east-west course.



The fundamental principle of course setting with the magneto compass

To eliminate the effect of the vertical component of the earth's magnetic field, when the plane is not level, the pole pieces swing together with a pendulum, which is damped to prevent oscillation.

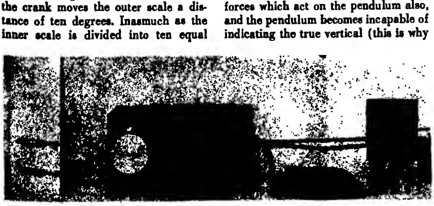
The directional effect being obtained by means of the position of the pole pieces and not by depending upon the exact position of the brushes, no errors are introduced by brush wear. Further, since the pole pieces are guarded against the effects of pitch or roll by the pendulum, the armature can be driven through simple shafting from the air impeller without the introduction of universal joints.

The compass indicator, of the galvanometer type, needs no detailed description, as beyond heavy jewel-type bearings and shock-absorbing mounting ring, it resembles the usual electrical instruments of this type.

When the magneto compass is installed, the course-setting controller is mechanically connected to the pole pieces of the generator and rotates them by means of either a flexible or rigid shafting, so that when the pointer of the indicator is centered the ship is headed in the direction indicated on the dial of the controller. The course-setting controller consists essentially of two concentric dials with a gear reduction so arranged that one revolution of the crank moves the outer scale a distance of ten degrees. Inasmuch as the inner scale is divided into ten equal parts, each of its divisions represent one degree. The combination of the two scales acts as a vernier to adjust the compass accurately and to indicate the course thus established by the pilot.

The electric turn indicator, combined with lateral inclinometer, is described in the text

While the pole pieces of the magneto compass generating unit are kept horizontal by the damped pendulum, the pendulum will not do everything. Rotation of the plane introduces centrifugal forces which act on the pendulum also, and the pendulum becomes incapable of indicating the true vertical (this is why so many means of stabilization on the pendulum principle have failed), and the effect of the vertical component of the earth's magnetic field introduces errors. When flying due north, in the northern hemisphere, the compass actually indicates a turn opposite to the one being made. This is the well-known northerly turning error. Accordingly, a turn compensator has been introduced. It consists of an electrically operated gyroscope and a zero center scale instrument connected by a single two-conductor wire of any required length.



Automatic steering control used with the magneto compass

The gyroscope is essentially a small electric motor mounted with its shaft horizontal and free to precess about another horizontal axis when affected by the turning of the aircraft. This precession changes the electrical balance of a circuit, causing the indicating instrument to read "right" or "left" turn as the case may be. The amount of precession is proportional to the rate of turning. The gyroscope is operated from the storage battery of the aircraft or from any equivalent source of electric energy.

The electric gyroscope may be used to compensate errors introduced by turning with the magneto compass. By means of a potentiometer, a potential is impressed upon a circuit of the magneto compass to buck the potential of the compass itself caused by the turn. The gyro unit may be mounted at any position in the plane and particularly is it useful when flying northerly courses in the northern hemisphere and southerly courses in the southern hemisphere, where the northerly turning error is of such importance.

The gyro element of the turn compensator may be used independently of the compass as a turn indicator to aid in maintaining the plane in straight

flight. A separate indicator is then provided for this use. Thus, the pilot has before him an indication of turns away from the course as well as the indication of the combined instrument in the magneto compass.

With the help of the magneto compass it is not only possible to give the pilot the exact course, but it is also possible to modify its use in such a manner as to give automatic steering. In this work a contact-making micro- replaces the compass indicator, and controls a clutch within the steering mechanism itself. It is, of course, necessary in such application to amplify the current generated in the magneto compass. The whole is a self-contained unit connecting directly to the control cables of the plane. Cost of automatic steering equipment has, so far, kept it from commercial use, but there is no doubt that, ultimately, automatic steering will come to the help of the commercial pilot, particularly as transport planes become larger and carry greater pay loads.

Panel in fuselage open, to show installation of the sonic altimeter in an Army airplane

THE magnetic compass is very accurate and, as we have seen, it is protected against pitching errors and against errors introduced by turning; but it is not protected against drift due to side winds. Visual drift indicators are sometimes employed for such a purpose, with specially arranged sighting devices which show whether the airplane is really following a compass course or drifting sideways to left or right of this course, but when there is fog, such drift corrections cannot be made; radio must then be employed.

Two types of radio signaling apparatus are now in use on the airways; aural and visual. With the aural beacon, the pilot listens for the dot-dash code of the beacon signal. When he hears a code letter of one kind, he knows he is to the right of his true course and steers to the left until the signal changes to a series of long dashes. When he goes past his course to the left, another signal apprises him of the fact.

With the visual type of beacon the pilot watches two vibrating reeds which are tuned to the frequencies of the beacon signal. Deviation to the right or left of the course is indicated by the unequal amplitude of the reeds. (See "Radio Guides the Airway Traveler," March 1929 SCIENTIFIC AMERICAN.)

For flying off the established airways, there has been developed a wing loop homing device which couples with a standard receiver and indicates to the pilot, by means of a meter on the instrument board, whether he is on or off his course. This device uses the ordinary broadcasting band and consequently may be directed at any broadcasting station within range of the receiver. Tests have shown that a pilot can fly to an average powerful broadcasting station from a distance of 200 miles.

A RADIO echo altimeter, by using radio waves reflected from the ground, gives accurate indications of altitude at periods of half the wavelength of the set. (See "A Radio Altimeter," December 1929 SCIENTIFIC AMERICAN.) In the early development of this instrument, weights of greater than 80 pounds were required, together with the use of seven tubes. The present outfit has been reduced to a weight of four pounds and uses but a single tube.

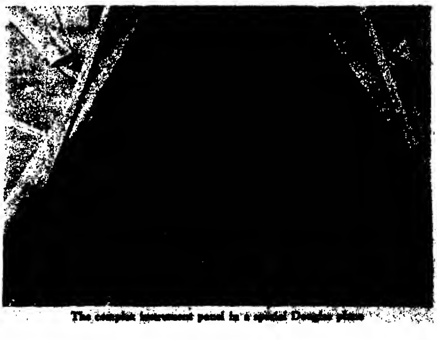
Another type is the sonic altimeter, on which the General Electric Company has expended much time and energy, and which is particularly useful for fog landings. In this device, a 3000-cycle note from an automatically operated air whistle is directed periodically at the ground by a megaphone. The echo of the outgoing signal is received in a second megaphone which is connected through a high-pass filter to a stethoscope worn by the pilot. A timing mechanism makes possible the indication of altitude. (For complete details see "Sonic Altimeter for Fog Flying," April 1931 SCIENTIFIC AMERICAN.)

WE have not mentioned the multiplicity of other instruments with which the modern airplane is equipped. Air speed indicators, temperature indicators, tachometers, pressure gages, fuel gages, and so on, form a bewildering system. The photograph of the special Douglas airplane cockpit gives an indication of the complexity of the nervous system of the modern airplane.

Nor have we discussed the light beacons, auxiliary airport beacons, airport markers, floodlights, and other aids to navigation; nor the system of weather broadcasting so useful at the present time. (See "The Pilot Phones His Airport via Radio," July 1930 SCIENTIFIC AMERICAN.) Space also will not permit us to deal with the radio methods for guiding the plane when quite near the airport, which have permitted the pilot to take off and land absolutely blind. Such experiments carried out by the Bureau of Standards have remarkable promise, though still only in the development stage. (See "Flying Blind—Guided by Radio," July 1931 SCIENTIFIC AMERICAN.)

Credit for such work is due not only to the General Electric Company and the Bureau of Standards, but also to the Pioneer Instrument Company, the Sperry Gyroscope Company, and many other organizations.

The intensive effort now put forth will soon result in perfect navigation under all conditions, with fog, the last of the great enemies of flying, completely conquered.

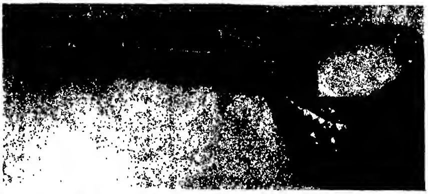


The complete instrument panel in a special Douglas plane

FROM THE ARCHEOLOGIST'S NOTE BOOK

An Etruscan Safety Pin

THE Metropolitan Museum of Art has just acquired a 2700 year old Etruscan gold fibula. It is one of the exquisite trinkets which are characteristic of the 7th Century Etruscan tombs. The pin is of stout gold wire, and the decoration is made up of double geometric rows of gold granules in zigzags and meanders. The length of the whole pin is 2¼ inches.



An Etruscan gold fibula with granular decorations, forerunner of safety pins

Eastern Stucco Statues

THE Stora Art Galleries of New York recently showed some remarkable stucco statues found in the neighborhood of Tash-Kourgan (Chinese Turkestan) to the east of the Afghan border.

Curious stucco figures from Chinese Turkestan show Gothic-Buddhist and Indo-Hellenistic influences

They display a mixture of Greek. Gothic, and Indo-Buddhistic features. For the artists of the Tarim valley stucco was what marble was for the Greeks. The modeling was done while the stucco was still damp. This period of Indo-Hellenistic culture sprang up in the wake of Alexander's conquests. This location was in the path of the "old silk road" which crossed the Gobi Desert. It is difficult to explain the Gothic influence in the one on left.

Excavating Rome's Seaport

WHILE Rome is being properly excavated in many quarters, its seaport, Ostia, has not been neglected by Premier Mussolini. Ostia is located at the mouth of the Tiber, 13½ miles from Rome. It was founded in the 7th Century B.C. The excavated ruins date chiefly from the 2nd-4th Centuries A.D. and include great harbor works, granaries, temples, fora, and theaters. The small bath which has recently been excavated has yielded an important headless statue. A complete necropolis has been uncovered in Ostia's island a the Ti e Aeneas landed.

Ostia, the port of ancient Rome, is being scientifically excavated and explored. *Left:* One of the small baths. *Above:* The statue of the Goddess of Fortune in a niche

A MODERNIZED UNIVERSITY LIBRARY

The book tower dominates the entire structure, is 16 stories high and houses 3,500,000 books

IN building a library, the tendency is to veer to the monumental. The stack is usually obscured behind a screen of monumental rooms or becomes the rear façade. In reality the essence of a library is the bookstack where tier after tier of self-supporting shelves house the books with narrow aisles giving access. In the recently dedicated seven million dollar library at Yale University the dominant idea was the placing of the stack in the most accessible and important position on the site as the dominating feature of the façade. This external expression of the functional core of the building gives the library a structural dignity and symbolism worthy of the great traditions of the University.

Architecturally the Yale library is a masterpiece and the symbolism and illustrative ornament stamp it as one of the outstanding buildings of the world. The Sterling Memorial Library named after the donor of the Sterling Foundation which has administered the funds bequeathed by Mr. Sterling.

At the base of the tower and in front of it the main hall, like the nave of a church with vaulted aisles, provides a dignified approach to the rooms of a more public nature, like the reading rooms and the exhibition rooms. The Gothic architecture adapted to library needs gives a feeling of spaciousness and calm which has an excellent psychological effect. The delivery desk at the end contains complete equipment for communicating with the stack and the various reading rooms. Access to the book stack is immediately behind the delivery desk. No visitor is admitted to the stack without a pass.

The bookstack tower is a working laboratory which is intended to bring readers and books quickly and easily together. The tower rises to a height of 150 feet and is built like a skyscraper with low ceilings. It is subdivided into sixteen floors or tiers by means of thin marble deck-floors, one and one quarter inches thick, and supported in the light steel horizontal framework of the bookstack. The waste space of thick floors is thus avoided, and the maximum cubical capacity of the building is utilized for the storage of books. Two thousand tons of steel and

Above: Reproduction, Yale library of 1742. Over 60 percent of the books were in the original library. *Right:* One of the 330 student's new stalls with shelves and desk

iron entered into the construction of the stack, and 1000 tons of marble in the floor and stair treads. All the steel connections were welded instead of riveted, resulting in a solid self-supporting, free standing, massive unit of steel. This was the largest welded job up to the date of construction. There are six and one half miles of aisles in the bookstack tower. The capacity of the bookstack tower is approximately 3,500,000 books.

Two stack tiers are equivalent to one building story and each two tiers of

Ozone generator makes ozone for ventilating system, preventing mold

stacks serve special departments. Books housed together for one department of study are, as far as possible, made accessible to all departments. The serious student need not use the main or special reading rooms as student carrels or cubicles are provided. The stack floors are equipped with cubicle partitions at the windows; in all there are 330 cubicles, each four by five feet. They are so designed that students studying spe-

cial subjects may be conveniently located with reference to their material in the adjacent stack sections. Each carrel is equipped with three adjustable shelves and a desk with a drawer. Here the student can collect the books which he needs and work in peace without the exasperation of finding the critical volume in the possession of another.

Naturally, readers who do not need facilities for such specialized work use the reading room. Book conveyors are of the greatest importance in connection with the stack. The conveyor pours down a continuous stream of books out of the stack tower to the delivery desk. The conveyor (described in the November 1929 Scientific American) consists of an endless chain which is continuously operated at a

Specially designed perforated light shades protect stack attendants from glare yet illuminate shelves

average speed of 75 feet a minute. Any obstruction causes an automatic overloading device to stop the conveyor instantaneously. Pneumatic tubes are used to send the call slips from the delivery desk to attendants' stations in the stack. Once the book is located it is placed in the carrier at the stack level and is automatically combed from the carriers into a receptacle at the delivery desk. The time required to transport a book from the farthest point in the tower to the desk is two and one-half minutes.

There are six elevators and two dumbwaiters. Two of the elevators are used principally for returning books to the shelves. Two of the elevators carry operators and are used by the students who enjoy stack privileges. The dumbwaiters are intended to carry small loads between the floors of the stack and are controlled by push buttons.

The heating and ventilating system is designed to meet local climatic conditions and three fundamental requirements. First, books and their preservation; second, the occupants of the building, both employes and students, and their comfort; third, equipment simple and durable and, at the same time, as inexpensive to operate as possible. There appears to be a

more or less well defined opinion of engineers that conditions good for human beings are good for books. The ideal recommendations are 68 degrees, Fahrenheit, dry-bulb temperature and 40 percent relative humidity.

Main reading room contains every convenience including mechanical dictionary racks

The system at the library is called the "split system;" that is, sufficient direct radiation is installed to keep the temperature of the building at 70 degrees, Fahrenheit, and the air for ventilating is delivered at room temperature. Equipment is provided to deliver 100,000 cubic feet a minute to the stack space. The air is delivered by three fans, one for the lower third of the stack which is entirely surrounded by other rooms, one for the center third which has some walls and windows exposed to outside temperatures, and one for the top third which has an exterior wall and windows on three sides. The plant includes air filters, humidifiers with steam coil and temperature coils in addition to fans, motors, and ducts. An interesting feature is an ozone apparatus from which ozone may be added to the circulated air. The object is to prevent mold from forming in the book bindings. Heat and light are provided from the central power plant of the University.

THE lighting of the stacks is peculiar and the plan was evolved for this library by the builders of the stack. In the aisles of the stack the shades are perforated with openings of various sizes and shapes to allow light from the lamps to illuminate the upper shelves, while the reflected light illuminates the lower shelves. The blank spaces and the spaces having the small holes serve to shield the eyes of those using the stack from the glare that is usually a part of book-stack illumination.

The public rooms of the library are very fine, including exhibition rooms, rare book room, and lecture rooms. A hall of "Yale Memorabilia" includes a section of the famous fence. There is also a room designed to reproduce as exactly as possible the Yale Library of 1742. Paneled in white pine and lit from narrow wood casements this room gives the atmosphere of nearly 190 years ago. Owing to the existence of an old manuscript catalogue it was possible to find and locate 60 percent of the volumes which originally belonged to the old collection.

Book conveyor brings books to delivery desk from all parts of stack

WHY QUESTION THE REASONING OF ANIMALS?

By S. F. AARON

THERE seems to have arisen a sort of foregone conclusion among biologists that all animal behavior is merely the result of instinct, however variously that word is defined. Mechanical automata is one phrase, inherited propensity and spontaniety are others, but there does not seem to be a clear comprehension of the workings of these forces or of their limitations.

All illustrations by the author

When old bay has an itching back, he touches young gray on the back at the exact spot corresponding to his discomfort, and gray starts to scratch. At the same time, guided by gray, bay massages a fly-bitten spot on gray's leg

The precise influences of heredity upon nerve-endowed creatures is too little understood and many observations bearing on the question have either been overlooked or commented upon illogically, even by such careful students as the accepted dean of American out-of-door naturalists, our late nature-loving ex-President, and many deservedly high-positioned natural scientists. There is, however, too much data on the subject, the interpretations of which are all too plain and the conclusions too obvious to permit the automata theory longer to rest content.

There is no need to resort to the far-fetched or the well-nigh impossible to prove the existence of the reasoning power in animals, though this too often has been employed. The writers of fanciful yarns wherein the impressions of hero wolves, bears, foxes, and rabbits have been rated in human values have hurt the cause of truth by exaggeration. On the other hand, much that has been designed to disprove animal intelligence has been absurd, as with the case of Burrough's cow that ate the straw with which the skin of her calf was stuffed.

ANIMALS can be impressed, and therefore must think and reason only within the scope of their own observations and memory. They possess little imagination or none, except as regards the fear of possible enemies. They also possess curiosity, which may be akin to imagination. One might as well suppose a South African bushman or a Hottentot should reason upon the transit of Venus or manage a problem in algebra as a cow to comprehend anatomy or taxidermy. Bossy knew her calf by the smell of the skin; she had no conception of what constituted its original interior. In fact, if fresh hay had exuded from her own sides she would have eaten that.

Consider the simple matter of nest building. In the construction of their houses beavers use more judgment with regard to floods than do many humans, and they always learn the value of caution. Is it fair to say that they do not weigh, compare, and decide intelligently regarding the most suitable spot for a dam and colony house, as influenced by the breadth and depth of the water, abundance of food and least danger of surprise?

I watched an orchard oriole select a position for her pensile nest in a pear tree not 20 feet from my study window. She fetched a long stalk of grass and stretched it from one branch to another, but it was not long enough to permit the slender upper end to give a firm hold when twice enwrapped. As though with impatience, she tore this away, let the stalk hang and, discarding the position, commenced to entwine a new strand of grass of the same length between closer branches five feet higher up the tree. She seemed to know she could obtain grass of this maximum length only. Is there any difference between the reasoning shown here and that which an Indian would show if his tepee poles could not be firmly implanted in one spot and he should change to another?

The crested flycatcher places a cast-off snake skin at the entrance to its nest in hollow limb or woodpecker hole. This forms no part of the actual egg-confining construction, but is supposed to be designed entirely for scaring away squirrels and egg-eating bird enemies. It is common for countrymen in remote sections to leave a light burning all night long as a warning to marauders. How much difference in the method or degree of reasoning is there between the adoption of these two means of protection? Or does each individual man get his idea independently and the bird only as a hereditary habit? Sometimes the birds omit the skins when these are plentiful. The human can explain his own purposes, but because the bird has not the power to convey in any way the reason for its choice of snake skin, can we assume that its universal act is only instinctive?

The Moro of Mindanao builds his hut of pita fiber, entwining it in a definite manner; this knowledge and the reason for his choice of material he has gained by long inheritance. The vireo builds its nest of grape-vine fiber, the choice of which is a hereditary matter, of course. Both man and bird somewhat vary the construction, the latter with its needle-like bill making rather the better job of it. No doubt both encounter difficulties that inherent knowledge could not have foreseen and both must use head work.

Choice as between two or more ways of reaching an effect must indicate a certain cogitation and the necessary comparisons are influenced alone by reason, though the ingenuity employed may be very largely an inherited tendency. There is a deciding point that compels a decision for the apparent best; otherwise there would be no variations, though these occur. The selection of chimneys instead of hollow trees by the swift, the adoption of bird houses and hollow gourds on poles rather than old woodpecker holes by purple martins, the improvements in nest building that one oriole shows from season to season over that of its first efforts, the use of paper, string, and rags by the catbird, cardinal, vireo, and other species, indicate clearly the reasoning selection of better materials, safer positions, and more care.

More remarkable, and still comparable to the methods of man, are the manners and habits of hunting, as specifically and variously practiced by

the more intelligent carnivora. The stealthy approach may be merely instinctive as is the sudden well-timed and measured leap, but overcoming the difficulties set by the intended victims, which often show an equal intelligence, demand nothing less than thoughtful strategy. With regard to this there is the choice of direction. It meets with varied, comparative Illustration.

When feeding chickens a simple experiment may be practiced by opening the yard gate, and then, as the flock surges through and follows a little way along the fence on the outside, a handful of grain is thrown over the fence and inside the yard. Most of the younger fowls and some of the adults instantly will try to sift themselves through the wire in a vain and frantic effort to get at the corn, but chanticleer and a few of the wiser hens will gaze but a moment at the delectable treat, then turn and make for the gate, going at first almost straight away from the grain. Now, hardly anyone can expect reasoning sense in a hen; her admirable care of her new brood is almost entirely instinctive, even in the brave battling against enemies, but to turn tail on food plainly in sight because of the memory of a sure way around can be nothing short of reasoning, however simple.

My trained setter loved nothing better than a run with his too indulgent master, but the director of domestic affairs had decreed that dogs, however well behaved and lovable, were not to trespass on the smooth floors and rugs of dining-room and hall. So Count, when called, dared to come, after careful instruction, only to the kitchen-dining-room door and there prance in expectant glee until hat and jacket were donned. The call of "come boy" and the opening of the hall door had no other effect than to send him directly away from the coveted invitation, out through kitchen and shed doors, into the yard and around the house, to join me at the front door. Is that reason or automative instinct? Analyze it for a clear answer.

On much the same basis our cat, which was a great hunter, though deprived of the opportunity by being kenneled throughout the bird-nesting season, spent some time in trying to surprise rabbits, especially one old long-eared buck that frequented the overgrown garden. On one side a large briar patch bordered the woods and in this bunny found ready asylum. The cat well knew that the rabbit could easily outrun him; the only hope was stealthy approach and surprise, but no method held any chance within that dense mass of thorns. So bunny was followed only to the edge of the briars, though the greedy feline eyes could easily discern the retreating hare within the shadows. What then? Merely an instinctive longing, or a further effort to brave the numerous thorns?

TRUST the cat's better brains; instantly he comes away and, out of sight of the rabbit, makes a wide detour, reaches the far side of the thicket where bunny is likely to emerge and there lies in wait, patiently, motionless, with a very good chance of successfully surprising the coveted quarry. If this is not reason pure and simple, then there must be some special name for it.

There is one trustworthy account, repeated many times in many localities, concerning as many dogs of various breeds, that clearly shows canine reasoning. These dogs are hunters of woodchucks and the dog so inclined watches long for the appearance of the digger, sneaks forward with belly close to the ground, gains a strategic position and suddenly dashes forward, not at the now alarmed groundhog which speeds for its burrow, but straight for the burrow, to head off the slower marmot.

Here is a sense of relative distances and an appreciation of the particular direction which is to be the most effective. I have witnessed a similar occurrence when a large weasel chased a red squirrel. The latter had gone up a trunk on a branch-to-branch course toward its nest tree. The weasel must have been formerly observant of the chickaree's dwelling-place, for instantly the killer ceased the futile pursuit upon vertical surfaces where the squirrel excels and, watching the latter's direction, immediately ran to the nest tree, ascended to a spot near where the squirrel would leap and waited for the out-maneuvered rodent.

The tricks, subterfuges, and actual wisdom of working elephants, the keen sensibilities of trained dogs, seals, and horses permit actual ridicule to be cast upon the assumption that animals act only through hereditary instincts. Perhaps we cannot entirely credit the yarn about the fox plucking wool from sheep, or selecting a mossy stick and then backing slowly into water until all the fleas have retreated to the wool or moss held just above the surface; whereupon reynard dives and lets the current carry the jumpers to their fate. Nor are we obliged to credit that old story of one closely pressed fox in the hunt leading the hounds to a certain leaning hollow tree where a fresh companion in hiding leaps out and away to distance the baffled hunters, the tired fox remaining in hiding. This latter would indicate a definite understanding akin to language.

But we do know from unquestioned

There is an authentic story of wolverines breaking the thread of a set-gun and then dragging the bait away without coming in range of the gun or setting it off. It n be conceded that mere instinct could not account for such a procedure

A cat, knowing the impossibility of pursuing a rabbit within the thicket, makes a well-planned detour to lay in wait where it feels sure the rabbit will emerge

observation that two prairie wolves will engage in co-operative hunting of jack rabbits, one coyote squatting where the too swift-footed and always circling quarry is started, the other running his best for one round and then dropping to rest while the fresh one takes up the chase. Thus they trade with each turn until they wear down the poor jack. This does not entail such a complicated understanding as to need a language; mates hunting together may chance on the opportunity and act each partially independent of the other, but both comprehending the advantage of co-operation, nevertheless.

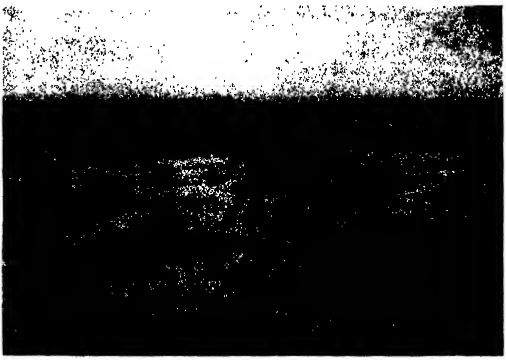
I witnessed the co-operation of two coyotes in attempting to pull down a calf, which would have been successful but for my interference. One coyote tried it alone, but was very effectively butted; it disappeared and in ten minutes came back with another coyote. This strongly suggested some kind of sign language, no doubt exceedingly limited, as is also shown by one sheep-killing dog inviting a hitherto innocent dog to join in a foray. Or does the second beast merely recognize the scent of the prey upon the first offender?

But because animals cannot in any certain manner express their thoughts and impressions or give even a partially lucid suggestion as to the purpose or choice of their actions, is it just that we shonld deny them the possession of ideas governing their conclusions? That able naturalist, Dr. Elliott Coues, in his remarkable monograph on the fur-bearing quadrupeds, can hardly be questioned as to accuracy, and while he quotes many authorities with regard to the wonderfully intelligent wolverine robbing traps, springing set-guns, avoiding deadfalls and the like, there must be a semblance of truth in the combined conclusions—enough to insure the belief in the creature's keenest reasoning powers. Others of the weasel family—notably the mink and pekan and that fellow long credited with wisdom, the fox—show degrees of intelligence by avoiding traps that can be due only to clearly defined reason.

The horse is by no means the intellectual leader among dumb animals; it possesses a rather limited understanding of dangers and often a perverse stupidity. However, we may look to the horse for the simplest, most easily obtained and entirely unquestionable evidence of thoughtful and reasoning action. Anyone with a little time and patience may go into rural pasture fields where two or more grass-filled and contented equines are resting in the shade, and witness the following demonstration. Gray and bay for a time assume a friendly attitude and stand head to tail, largely for the purpose of having flies switched from the heads of each. There is nothing they like better than to have their frequent itchings allayed, for which purpose they seek tree trunks, fence posts, and low limbs against which to scratch. But better is the tooth or tongue scratching that they give each other in a most decidedly co-operative and understanding manner. Gray has a fly bite on his hind leg and with his nose he gently touches bay's leg in the spot to correspond with his own itching. At the same time bay, having an itching back, barely touches gray on the back. Whereupon instantly bay begins to scratch gray's leg and gray begins to scratch bay's back.

NOR is this all. Should one wish the other to use its tongue instead of teeth it indicates this by touching the desired spot on the other with its tongue. Gray, having his itching allayed, merely lays back his ears and bay stops; then gray touches bay on the ribs and bay gets busy on gray's ribs.

I have witnessed the above on several distinct occasions and I think it may be included with other evidence to settle once and for all the question as to the reasoning of animals.



A coyote attacks a range calf and finds that he cannot finish the job alone. He trots away and shortly returns with a companion and the two make the kill. Is this "instinct" or reasoning?

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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American Navy Building Program Lags

JULY 21 was the first anniversary of the ratification by the Senate of the London treaty for the limitation of naval armament, but in those 12 months Congress did not authorize a single ship of any of the types covered in the treaty. It did appropriate money, however, to begin the construction of 11 destroyers which were authorized more than 15 years ago as a part of the 1916 program.

When the London treaty was signed, and after it was ratified, the Navy Department began working out a construction program to modernize the fleet to conform to the provisions of the treaty.

A program calling for a first treaty authorization of one aircraft carrier, three submarines and two 10,000-ton cruisers armed with 6-inch guns, one of them an experimental type and the other to be a flying-deck cruiser, was sent to Congress with the approval of the administration.

The program made no headway at all, and the destroyer appropriations which had been postponed year after year, were finally authorized only after pressure from the White House.

The other powers signatory to the treaty have been moving forward, however, in the direction of achieving treaty strength.

In the years prior to 1930, back to 1922, when the Washington treaty for limitation of naval armament was signed, the United States laid down no destroyers. Moreover, the first of the 11 appropriated for by the last Congress will not be laid down until the coming winter.

In the 1922-30 period Great Britain laid down 22 modern destroyers, France 48, Italy 37, and Japan 47. In submarines during those eight years France laid down 67, Italy 32, Japan 35, Great Britain 19, and the United States 3. One of the American submarines is to be completed in August of next year, the second in 1933, and the third late in 1934.

Now one year after ratification of the London treaty, the United States has 11 vessels under construction, all of pre-treaty authorization; Great Britain has 30, Japan 17, France 60, and Italy 19.

In addition, the United States has 11 appropriated for, Great Britain 19, France 18, and Italy 29. The figures for Japan are not available.

Of the authorized vessels the 11 of the United States are destroyers; Great Britain's comprise four 6-inch-gun cruisers, nine destroyers and six submarines; France's, one 6-inch-gun cruiser, six destroyers and 11 submarines; Italy's, one 8-inch-gun and two 6-inch-gun cruisers, four destroyers, and 22 submarines.

Of aircraft carriers the United States has two completed and one building, Great Britain has six in commission, and Japan one building and three in commission.

Even when the *Ranger*, now building, is completed, the carrier tonnage of the American Navy will still be 45,000 tons short of the treaty limit. Congress failed at its last session to authorize the second carrier of the *Ranger* type asked for by the Navy Department.

During the life of the London treaty the United States is permitted to lay down in new tonnage 44,914 tons of aircraft carriers, 80,000 tons of 8-inch-gun 10,000-ton cruisers; 87,000 tons of 6-inch-gun cruisers; 150,000 tons of destroyers; and 52,700 tons of submarines.

The ancient vintage of the destroyer and submarine tonnage of the Navy is apparent in that the new tonnage alloted for these classes, so far as the United States is concerned, is the maximum limit fixed in the treaty. The 80,000 tons of 8-inch-gun cruisers is completed or building, although 30,000 tons cannot be completed during the life of the treaty. The 6-inch-gun cruiser allotment of new tonnage remains untouched.

Great Britain and Japan have their 8-inch-gun treaty tonnage in the water, Great Britain having completed about 40,000 tons and Japan about 75,000 tons of their respective allotments. In aircraft carrier tonnage, Great Britain has only 19,650 tons and Japan only 12,030 tons to go before reaching the limit fixed by the treaty,

The largest and most powerful locomotive on the North American continent: The Canadian Pacific's new "8000" type, multi-pressure locomotive. Its length is 100 feet and its weight 400 tons. It is to be used in heavy freight and passenger service in the Canadian Rockies where it will afford a saving of one third in fuel costs. Firebox and combustion chamber have a total of 3½ miles of seamless steel tubing wherein steam is generated from *distilled water* which is recirculated without loss. The tender carries 12,000 imperial gallons of water and 4100 imperial gallons of fuel oil

while the United States remains 44,914 tons below the limit.

The 1931-32 programs of the treaty navies provide: For Great Britain three cruisers, nine destroyers, and three submarines of a total tonnage of 33,375; France, three cruisers, including one of 23,000 tons and

Unfolding the light brackets under the new illuminated bridge table

two submarines of a total tonnage of 38,600 tons, and the United States 11 destroyers of 16,500 tons. The Japanese and Italian programs for 1931-32 are not available in Washington.

When the new Congress meets in December, the Navy will offer its 1932-33 program. It probably will call for one aircraft carrier of 13,500 tons, two 6-inch-gun cruisers of 10,000 tons each and at least six destroyers and two or three submarines. However, there is no indication that Congress will approve such a program.

Well, there's one consolation. We now have Old Ironsides back in commission. Then too, we still have the *Rochester*—and the *Galveston* could be recommissioned in an emergency.—*Our Navy.*

Angle Trisection Impossible with Ruler and Compass Alone

TRISECTING the angle with ruler and compass alone is just as impossible today as it was in the days when the ancient Greek mathematicians worried over the problem centuries ago, mathematicians commented recently in connection with reports that this problem had been solved.

A simple exercise in the theories of numbers which is worked by juniors and seniors in college mathematics courses demonstrates the impossibility of trisecting angles in general without the use of complex curves. There are a few special angles that can be trisected by use of the straight line and circle alone. When claims are made that the angle has been trisected by plane geometry, it turns out that one of these special angles has been used or there is some mistake in the work.

By using special curves such as the conchoid or the quadratix of Hippias, trisection of the angle is possible, but t' use of these three-dimensional curves w frowned upon as unsportsmanlike by the Greek mathematicians and solution by conic section methods was not considered a true solution of the original problem.

Squaring the circle, duplicating the cube, and trisecting the angle were the three problems that intrigued the Greek mathematicians and started them on the way to discoveries of many important results in mathematics. During the centuries many thousands of attempts have been made to solve the trisectional problem. —*Science Service.*

Vitamins in Apples

BY peeling apples before eating, one deprives oneself of the most healthful part of the fruit, according to the results of recent studies reported by the British Food Investigation Board. It has been found that the vitamin content of the peel is at least which exists in the regio of the core.

The same source reports that while studying the diseases of apples in cold storage it was found that healthy fruit absorbed acetaldehyde, and, at the same time, protection from the attack of fungi was afforded.—*A. E. B.*

Illuminated Bridge Table

CONVENIENCE is one keynote in our daily mode of living and particularly is it desirable to entertain in our homes with as much ease and comfort as possible. When the entertainment is to be an evening devoted to bridge, it is indeed a pleasure to know that the game will be played under comfortable seeing conditions. Mr. Dan A. O'Connell, Jr. and Mr. A. Buchan at Nela Park, Cleveland, appreciated these facts when they recently designed a novel bridge table on which a patent will soon be issued.

As the illustrations show, this lighted bridge table has the lighting equipment built as an integral part of the design. Two diagonally opposite legs of the table carry the lighting fixtures. Small sections of nickel-plated pipe, with thumb screw joints for adjustment, support lamp sockets and trough reflectors which accommodate 25-watt T-10 bulb Mazda lamps. The lamps d reflectors are located slightly below the e level so that the light is directed on the playing area and concealed from each individual's eyes. Uniform distribution of light results. Ornamental, as well as useful, ashtrays have also been provided as a part of the plan, and, a cigarette lighter may be conveniently attached to the receptacle provided.

At the conclusion of play the entire equipment on the table may be folded away beneath the table.

Making Dollar Bills From Cotton

AMONG the many suggested ways of ending the business depression is that of the wag who proposes that money should be made out of rubber so it could be stretched further. In all seriousness, however, champions of the cotton belt have proposed the use of paper made entirely from cotton for Uncle Sam's paper money as a step to improve the plight of the cot- rowers. Upon investigation, however, 'reasury Department has rejected the suggestion that all-cotton paper be used n the manufacture of one-dollar bills instead of linen-cotton, which is now employed for all U. S. paper money because has been found n the suggestion, which came n the Galveston Chamber of Commerce, the acting secretary of the Treasury said that cotton paper once before had been used in the manufacture of currency but that it lacks certain essential properties. —*A. E. B.*

Pellagra

SCIENTISTS of the National Institute of Health at Washington are seeking to ascertain the crops having the highest pellagra preventive values which may be grown most easily by farmers in the areas in which pellagra is prevalent. The nutrition specialists of the United States Public Health Service, working at the Institute, hope that their studies will result in a practical solution of the problem of preventing pellagra, a nutritional disease, which has become widespread in parts of the dry area. When the most valuable antipellagric crops are determined, this infor-

The illuminated bridge table in use. Note absence of glare

mation will be passed on to state, local, and county health units by the Public Health Service.

In conjunction with its study of the nutritive value of crops, the National Institute of Health is attempting to concentrate—and if possible to isolate—the pellagra preventive vitamin. The anti-pellagric vitamin never has been isolated, although its presence in specific foods is proved by the pellagra preventive effects of such foods when they are eaten.

The Institute, or Hygienic Laboratory, as it was known then, discovered the cause of pellagra. This discovery is probably one of the most significant steps forward in public health advancement during the last decade. The late Dr. Joseph Goldberger of the United States Public Health Service found that pellagra was caused by the lack of a certain nutritive substance, or vitamin, in the diet. (See page 272, October, 1931 SCIENTIFIC AMERICAN.) This finding threw a new light on pellagra, and has made possible the beneficial work now being done by the Public Health Service in attempting to eradicate pellagra.

Vinegary Beauty

AMONG the latest aids to beauty is the vinegar shampoo. In conveying the vinegar to booths in the beauty shops, pure nickel tubing and fittings are used because they resist the corrosive effects of the weak acid present in the vinegar.

"Rub-less" Floor Polish

"RUB-LESS" polish is one of the latest developments based on recent chemical discoveries. Thanks to new and efficient emulsifying agents, wax can be kept in a homogenous solution which, when applied to certain surfaces, hardens with the typical gloss and sheen that was formerly attained only at the cost of much "elbow-grease." The polish dries in about 10 minutes to give a high luster surface which is more durable and less slippery than that obtained in the old-fashioned way.

These new polishes are marketed in the form of plastic, emulsified carnauba wax to which an equal amount of water is added, with stirring. The resulting solution is spread uniformly, like a thin coat of varnish, over the surface to be polished, and allowed to dry. It is being successfully used on asphalt, cement, linoleum, mastic, marble, oilcloth, rubber, terrazo, and tile. —*A. E. B.*

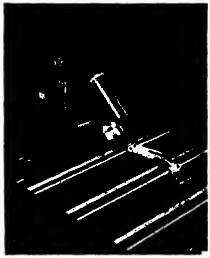
Machine Plays Solitaire: Sorts Cards

A ONE-EYED machine that can read and assort millions of ordinary printed cards at a high rate of speed, science's latest tool for use in accounting departments of large organizations for the classification of bills, checks, tickets, and other records, was announced recently by S. M. Kintner, Vice President of the Westinghouse Electric and Manufacturing Company.

Developed and designed by Douglass A. Young, an engineer of the Westinghouse organization, this ingenious machine not only reads cards, but places them in any of the 100 compartments in the machine where they belong without any human hand touching them. The machine, which is operated by a single photo-electric tube, reminds one of a man playing solitaire, and resembles in appearance a miniature railroad switching terminal with the card being routed over its proper track and delivered to its proper destination.

The development of this latest electrical and mechanical device is the result of a request from an executive of a large corporation. This particular company, like many others throughout the country, sends bills to its customers every month. Part of the bill (the stub) is returned to the company by the customer with his remittance. The classification of these stubs, which are returned at the rate of many thousand per day throughout the month, upsets the entire organization as it is almost impossible to keep help on the tedious and monotonous grind of sorting and filing the returned remittance stubs.

Operation of the machine is so simple that it requires the services of only one person. When the names and addresses are stenciled on the bills, a number is printed also. This number guides the sorters in the classifying of the stub when it is returned. With the new sorting machine, this same principle is carried out, except that a simple printed code is substituted for the numbers. By this code system, according to Mr. Young, it is possible to get over one hundred million combinations of numbers on a card $1\frac{1}{2}$ inches wide by $3\frac{1}{4}$ inches long and still have enough room for the name and address of the customer.



The photo-electric cell which scans the cards and does the "brain work" of the card sorting machine

When the operator is ready to start sorting, after turning on the power, he places a stack of cards in the feeding receptacle of the machine. A weight is then placed on the top of the cards which puts pressure on the card at the bottom of the pack. This lower card is then picked up by an ingenious device covered by live rubber, which operates effectively even with badly mutilated cards. The rubber-covered device then pushes the card forward under the photo-electric cell and the coded number is read before the card is routed to its proper place. The reading of this card by the cell is done in the fraction of a second that the card passes under its gaze. After reading the code on the card, the photo-electric cell transmits signals to the relays and trip switches and these cause a mechanical hand to respond ready to take the classified card to its proper place in any of the 100 compartments in the machine.

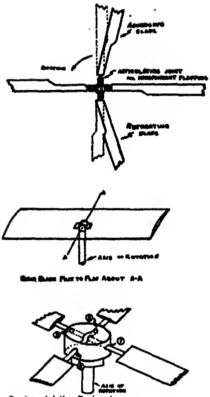
The machine that accurately sorts cards by the million

Pills Instead of Spinach

IF you have any youngsters of the spinach-refusing age, you may soon be able to offer them the stuff that spinach supplies in a form which they may not like any better—as a powder or a pill.

Carrotin, a yellow coloring matter that is present in green leaves as well as in the yellow carrots for which it is named, seems to be identical with the long-sought basic material of vitamin A. By a new process, described before the American Chemical Society, it can be produced from carrots in highly concentrated crystalline form, at low cost, and comparatively rapidly. The discoverers of the new process are Drs. Henry N. Holmes and Henry M. Leicester of Oberlin College.

If you dislike both eating spinach and



Courtesy *Aviation Engineering*

Different rotating airfoil principles as discussed in the article at right: A Rival of the Autogiro?

swallowing pills, you can get your vitamin A or your carrotin by taking a "shot in the arm," with a hypodermic needle, just as protection against a lot of infectious diseases is now commonly administered.

The discovery that the injections are possible was announced by Dr. R. G. Turner of the Detroit College of Medicine and Surgery. He gave such injections to a lot of animals suffering from a lack of vitamin A, and compared their rate of recovery with a set of "controls" given vitamin A with their food in the ordinary manner. The injected animals recovered their health.

Although carrots have thus been shifted from their old job as a "beauty food" to a new one as a health food, chemists still come to the rescue of beauty in distress. Beauty parlors are beginning to use solid carbon dioxide, sold under the trade name of Dry Ice, for post-massage rubdowns instead of the old familiar, but somewhat wet and messy, lumps of ice. Solid carbon dioxide evaporates into a dry gas instead of melting into water.

It must, however, be rubbed on lightly and skillfully, warned Dr. D. H. Killeffer of New York, for it is so cold that a too intimate contact will result, paradoxically [illegible] painful burn.—*Science Service.*

Trial Flights of the "Akron"

THE *Akron* has been christened by Mrs. Hoover and the huge airship will soon be taken over by the Navy. But that does not mean that the *Akron* will immediately pass into practical service. First she will have to pass a rigid and exhaustive series of airworthiness tests, flying 75 hours in at least five separate flight tests.

The maiden flight will be a short trip of [illegible] hours duration at normal cruising speed. Then she will be tried out with various combinations of the engines in use, so that characteristics with any combination of engines out of commission will be ascertained. An endurance test of 48 hours duration will have to be met, with a speed of 50 knots maintained for at least 12 hours. The *Akron* must also show that she can climb at least six meters (over 18 feet) per second and descend at more than 12 feet per second.

An airship normally gets its lift from the buoyancy of the gas cells, but if its nose is raised in flight she has a dynamic or airplane type of lift. (Hence the frequent suggestion of a combination plane and airship type.) The dynamic lift is a safeguard against overweight and the *Akron* will have to be able to maintain altitude when actually 10 tons over weight.

Coming in and out of hangars, cross winds are often a source of trouble. The *Akron* must be taken out of the dock at least once in a wind higher than 10 miles an hour with a sidewise component exceeding five miles per hour.

When Commander Charles E. Rosendahl, assisted by a competent staff of technical officers, has put the new ship through all these paces, the American public may be quite sure that the Navy has made a worthwhile though expensive acquisition.—*A. K.*

A Rival of the Autogiro?

THE wide-spread public interest in the Autogiro and its remarkable accomplishments, give more importance to other systems in which lift is obtained from a rotating blade system in lieu of the fixed airplane wing.

By courtesy of *Aviation Engineering* we reproduce a diagram of three of the systems which may be employed.

In all three systems, the blades are fr
rotate about a central, almost vertical,
No power is transmitted to the blades, but when the craft is set in forward r
by an ordinary engine-driven propeller, the sustaining blades are set into auto-rotation by the action of the air, and turn like giant horizontal windmills.

In the first system shown in the diagram, the one employed by Cierva, the blades are hinged at the center on a horizontal pin, and are therefore free to "flap" up and down. The blades, being free to flap, take up a position of equilibrium determined by their weight and the centrifugal force. The blade advancing into the wind rises, the blade receding from the wind falls, and lift equalization is complete.

This lift equalization on either side is one of the first problems which the designer of a rotating airfoil system has to solve.

The second system of a rotating airfoil is simpler in principle. The blade is continuous on either side of the machine, and is hinged about a single horizontal pin. The single surface rotates about a vertical axis, and flaps about the horizontal hinge to equalize the lift on either side. A machine built on this principle was not very satisfactory, but more may be heard of this system in the future.

In the third system, the blades do not "flap" but "feather" or oscillate about a hinge which runs parallel with the length of the blade. The center of pressure of the feathering blade is placed behind its hinge, so that the blade advancing into the wind has its angle of incidence diminished, while the blade receding from the wind has its angle of incidence increased. Thus equalization of lift is again obtained.

E. Burke Wilford, who has been active in developing this third system of the revolving airfoil machine, is shown in our photograph with his third machine of this type, which is still in the experimental stage, and has only risen a few feet from the ground so far.

For the Wilford Gyroplane, as it is termed, the aerodynamic equivalent of the Autogiro is claimed, as are also certain mechanical simplifications. The Gyroplane has, however, to meet certain other difficulties.

It is for the good of the revolving airfoil idea that there should be emulation between various principles. Therefore further experiments with the Wilford Gyroplane are awaited with interest.—*A. K.*

Improving Rules for Airplane Safety

THE increasing safety of scheduled flying is in a large measure due to the cooperation between the Department of Commerce and the transport operators. At least once a year, representatives of the Government and of the operators meet in Washington and after much argument amend existing rules and agree on new ones. This year's session raised some particularly interesting points.

How often should the engines be overhauled? The existing rules call for overhaul at least once each 400 hours. The operators,

Courtesy *Aviation Engineering*

Mr. E. Burke Wilford, inspecting his Gyroplane, a distinct departure from the well-known Autogiro

pointing to the increased reliability of the aircraft power plant wanted the period extended to 750 hours, or even left to the discretion of the air line!

Should there be a co-pilot? The argument in favor of the co-pilot is that a single pilot may become unconscious or unable to carry on for some reason or other. A co-pilot is now required in any plane accomodating 15 or more passengers. Operators object to this rule and suggested that a co-pilot should be required only in a multi-engined plane, with more apparatus to watch over and only when the pilot has to fly 6 or more hours in one day. Even though the pilot's pay has gone down considerably,

the salaries of flying personnel are an important item in the operators' budgets.

The Department's rules call for a steward in all aircraft having a passenger capacity in excess of eight. Secretary Young concurred in the elimination of the steward, even though there have been cases recently of a passenger becoming violent and having to be subdued by force.

Universal requirement of two-way radio seems to be closer as a result of the last conference. Flight is prohibited under 500 feet altitude. Operators were anxious to reduce this height and the Department presented a tentative regulation prohibiting operation over clouds unless the "ceiling" at the terminal airport was known to be under 300 feet, or, alternatively, 2000 feet over the route at the time of take-off.

These and other points will gradually be settled as experience accumulates until the rules of the air assume the same comprehensive and satisfactory character as the rules covering vessels at sea. At this stage no one can be said to know exactly what the rules should be to cover all possible contingencies.—*A. K.*

A Debate About the Autogiro

THE editor of the London *Aeroplane*, C. G. Grey, has been a familiar and important figure in aviation for many years. An Irishman, he has a witty and caustic tongue, and a still more caustic pen. Sometimes this critic is completely wrong; sometimes he is completely and discomfitingly right: always his views are striking and thought provoking. Recently Mr. Grey took a bad rise out of the Autogiro.

An Autogiro lands very much more slowly than an ordinary airplane, but its high speed is correspondingly less. Mr. Grey's view is that if an airplane were built that had as much power as an Autogiro, carried as little useful load, and flew as slowly as the Autogiro, then that hypothetical airplane could get off the ground just as quickly as the Autogiro and could be made to land just as slowly. An Autogiro could get in and out of a football field, but so claims Mr. Grey could this hypothetical airplane.

What Mr. Grey would like to know is how the Autogiro would behave under a dead-stick landing. Also his fears are roused by the possibility of one of the blades being injured in some way and by the dangers of an unbalanced rotor system.

The New York Times gave Harold F. Pitcairn, the energetic, persistent, and able exponent of the Autogiro in the United States, an opportunity for rejoinder.

Mr. Pitcairn's arguments are all the stronger because they are based on experience and not conjecture. The reply as to slow speed merits direct quotation.

"Regardless of wing area and loading, airplanes cannot be made to land as slowly as Autogiros. All heavier-than-air machines support themselves by deflecting air downward. In other words, the machine is supported because air has weight, but since the air weighs so little a tremendous quantity must be deflected to support an aircraft. This means that if lift and control are to be maintained the surface or surfaces which are deflecting the air must move at a high rate of speed. Therefore, slow flight requires that the speed of the lifting surface be independent of the speed of the aircraft. Also if the wing loading of an airplane is very light, it will be immeasurably harder to land in high winds than an Autogiro. Lightly loaded airplanes are notoriously rough in bumpy air. The Autogiro on the other hand smooths out many more air bumps than does a heavily loaded airplane."

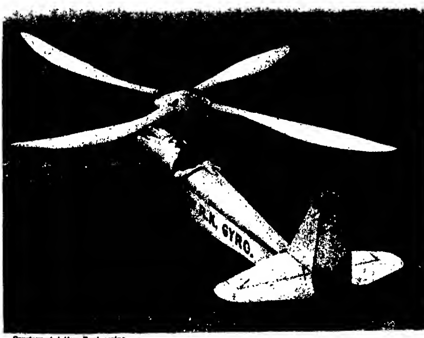
Mr. Pitcairn supports his views by relating personal experiences. For a month he has flown his Autogiro from the lawn of his house to the factory, much as he would use an automobile. He and his pilots have made innumerable dead-stick landings. Mr. Pitcairn has flown in weather so thick that he would never have ventured forth in an airplane. "The ability to come almost instantaneously to a momentary complete stop when flying at 40 miles an hour and then descend practically vertically into a small plot of ground has incalculable value when flying in thick weather."

The American constructor makes light of the danger of hitting a bird or otherwise damaging a rotor blade: "I do not attach any importance to Mr. Grey's mistrust of the revolving joint that attaches the rotor to the fuselage, since in all cases this is made with exceptionally large factors of safety. Neither am I afraid of the rotor

A Kellett built Autogiro flying low but at ease over a golf course

blades being struck by birds, because I have known of pilots who have made every effort to hit birds while flying airplanes, but I have never known of a bird being hit. Birds see the machine coming and get out of the way."

The writer of these notes has recently had a delightful ride in the Autogiro with Mr. Pitcairn himself as the pilot. It made a lasting impression, and the writer tempted to set both Mr. Grey and : Pitcairn right, but that perhaps would in dubious taste. Far better to give tl both merely the courtesy of the colun —*A. K.*



Courtesy Aviation Engineering

[illegible], which is similar to the Autogiro in having a rotating airfoil system, but in which the blades feather about their longitudinal axis instead of flapping up and down about a central hinge

"Cruisers of the Air"

THIS book, by C. J. Hylander, is a concise and well illustrated story of the development of the airship. Neither original nor profound, it is nevertheless an interesting book for a boy wishing to know something of the airship or for an adult seeking an elementary background for the important lighter-than-air developments of the day.—*A. K.*

Separating Water and Gasoline

MANY an aviator has found himself on the brink of disaster when water or dirt have got into the gasoline and disturbed the delicate jet system of the carbureter.

It is at present the custom, in the Army Air Corps, to filter the gasoline through chamois strainers held in a fueling funnel. The process is tedious and troublesome, particularly because the chamois cloth has a way of developing mysterious holes. The

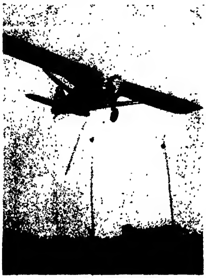
patience of the most trustworthy mechanic is apt to be sorely tried, the filtering process unduly hastened, and the way paved for an unfortunate stoppage of the airplane engine.

Master Sergeant David Samiran, with full co-operation of the Army Air Corps authorities has now developed a simple yet highly effective "gasoline segregator."

The segregator takes advantage of the natural tendency of water and gasoline to separate due to the difference in their specific gravities. The segregator's fluid chamber is so arranged that when the liquid fuel enters the chamber, the heavier water is delivered to the bottom of the chamber with a minimum turbulence while the gasoline is delivered to the outlet at the top with a minimum turbulence, after passing through an efficient sediment strainer. When enough water has accumulated in the bottom of the segregator, a float rises automatically, opens a valve, and the water is discharged. When the water is gone, the float falls and the water valve closes.

Laboratory tests, as well as installations at airports and at filling stations for motor boats have given excellent results. Small size segregators will help the ordinary motorist.

We believe this simple device will have wide and useful applications.—*A. K.*



The Cabot airmail pick-up—latest of its kind—being tested in conjunction with a Bellanca plane

A Mail Pick-up Device

SINCE the construction of an airport where mail planes may land means a minimum expenditure of some 30,000 to 40,000 dollars and a certain amount of annual expenditure in upkeep, the use of an airmail pick-up device has long been considered attractive. A number of inventors have attacked the problem, and one of the most persistent and thorough workers in the field is Godfrey Cabot of Boston. Demonstrations given recently of Mr. Cabot's invention have drawn favorable comment from many authorities. Its use in smaller cities, where stopping the transcontinental mail planes would hardly be justified, is quite a possibility.

The device consists of a catapult actuated by a series of half-inch shock cords and mounted on top of a light three-wheeled vehicle. The catapult propels a carrier along a runway. When ready for action the device is so oriented that the incoming plane may fly into the wind. The mail sack is placed in the carrier, and the 50-foot pick-up cord is placed on the tops of two 16-foot uprights, which are mounted on the body of the vehicle. These uprights are attached to the trigger of the device so that when they are moved slightly forward the trigger lets go and the catapult is released.

The uprights are 15 feet apart and the pilot aims to strike, with the pick-up hook, the middle of the cord stretched between them.

The moment the hook strikes the pick-up cord, the catapult starts and the carrier goes forward in the direction of flight at the same speed as the plane. The result is that the mail sack is lifted from the carrier without a jarring shock to the airplane.

The plane is equipped with a windlass which is automatically operated. The pick-up hook guide, 12 feet in length, is of steel and has a lengthwise groove in which the hook rides. The moment the weight of the mail sack is felt by the hook, a windlass begins to turn automatically and in less than a minute the mail sack is wound up into the cabin of the plane, through a port in the bottom of the fuselage. It is only necessary to release the windlass to unreel the shock cord. In practice this cord would be dropped at a specific place and a post-office employee would pick it up for further use.

The action of the catapult can be adjusted so as to suit the speed of the plane.

In official tests the specifications of the Post Office Department were followed. The loads picked up ranged from 5 to 40 pounds, although it is claimed that loads up to 1000 pounds could be handled. The tests did not fail in one instance.

It would be interesting to see the device actually tested in service on an airmail route.—*A. K.*

Lessons of the DO-X Flight

HERE is what we learn from the flight of the *DO-X*—its many troubles, mishaps, and minor shortcomings notwithstanding:

That a practical giant flying boat of a gross weight of some 106,000 pounds can be built.

That it is perfectly possible to co-ordinate and properly run a power plant consisting of 12 engines.

That the limit of size of the flying boat can be vastly extended and that while the *DO-X* is not the last word in speed and economy of operation, the way is clearly open to very large flying boats.

That very large flying boats lend themselves to the installation of radio and other equipment as complete in character as that of an ocean liner.

That seaworthiness increases with size (as we have always anticipated).

That steadiness in the air and comfort of the passengers increases with size.

The design and construction of the *DO-X* constitute a remarkable achievement, not because the *DO-X* will be immediately put into practical and profitable operation, but because it points the way for the constructor and operator, and because it shows conclusively that in a very few years, boats of even greater size may be possible both from a technical and commercial point of view. We may even look forward with confidence to regular seaplane operation across the Atlantic.

The flight of the *DO-X* constitutes a historic event in spite of the malicious jokes at its slow and cautious trip from Germany to New York.—*A. K.*

The giant flying boat *DO-X* after her arrival at New York

Save the Pieces

WHEN the housewife sweeps, she is not trying to recover some missing pieces of costly platinum. However, in factories where lamps for switchboard signals are manufactured, this is one of the jobs the sweeper must do.

Platinum wire is used in this manufacture and some of the platinum gets lost in handling, particles dropping on the floor. One way of getting them is with a small magnet, but a magnetic sweeper is also used. The sweeper consists of several individual magnets placed side by side on a frame, which has wheels and a handle. Several times a day the sweeper goes over the floor collecting bits of platinum.

The First American Book on the Helicopter

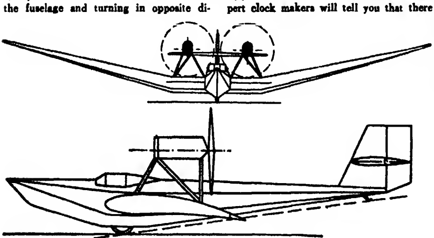
ALTHOUGH the helicopter has been the subject of innumerable articles in the daily and technical press, we do not remember ever having seen a book written in English dealing with this most interesting type of aircraft. "The Problem of Vertical Flight," by Parlee C. Grose is therefore very welcome, though it is not free from many criticisms on the score of technical accuracy.

The direct lift machine has received attention from very early times. Leonardo da Vinci left sketches of a machine involving an immense screw turning about a vertical axis. Sir George Cayley, in 1809, experimented with a model in England which involved four large airscrews for vertical lift and two smaller four-bladed propellers for horizontal flight. In 1877 Enrico For-

lanin (of Italy) designed a model helicopter powered with a miniature steam engine which established a record—the machine was the first to leave the ground vertically. Edison undoubtedly gave the type much thought in the early stages of his career. Since then scarcely a year has passed without some new inventor coming on the scene.

Two screws, coaxially mounted, and rotating in opposite directions have been tried; two screws mounted on either side of the fuselage and turning in opposite directions have been used; there have been combinations of lifting airscrews with ordinary airplane wings, combinations of lifting airscrews with gas filled balloons, inclination of lifting screws to give forward speed, combinations of lifting screws with smaller propellers to give forward propulsion, and so on and so forth.

While complete success has not yet apparently been attained it would seem that the ultimate solution is coming closer and closer. Misleading as Mr. Grose's book may be in many technical points, it is nevertheless interesting as a concise and fairly complete review of the history of this particular art.—*A. K.*



Courtesy *Le Document Aéronautique*
Diagrammatic sketches of Dr. Merkel's combination wing-float

A Combination Wing and Float

THE question is often asked why a seaplane or flying boat should, for the same weight per horsepower, be slower or else carry less payload than a land plane. The answer is that the flotation system is likely to be heavier and to offer more air resistance than a landing gear.

Dr. W. Merkel, a Director of the German Lufthansa now proposes a combination wing and float which offers a chance of removing this handicap for the seaplane. The new type of craft is also an amphibion.

The amphibion in question is a low-wing monoplane with two engines mounted high above the wing. The well streamlined central body is at the same time a hydroplane float. Instead of having tip floats for lateral stability, the wings themselves, at their central section, act as flotation bodies, and therefore provide the necessary lateral stability. The outer portions of the wings are raised so as to be clear of the water. Of course the aerodynamic properties of the wing will not be quite as good as those of conventional wings, but the combination as a whole may be very efficient.

To avoid the possibility of damaging the wings in rough water, they are given a certain elasticity of construction, with the trailing edge portion elastically supported in reference to the rear spar.

As can be seen from the sketches, a single central wheel and a tail skid give Dr. Merkel's design the ability to alight on or take-off from land.—*A. K.*

Oil For Chronometers

WHAT kind of oil should be used to lubricate clocks and watches? Expert clock makers will tell you that there is only one kind of oil that is entirely satisfactory, namely the oil extracted from the head and jaw of the porpoise and blackfish. For many years, this oil has been standard for the purpose but now it can not be supplied in sufficient quantity to meet the demands, the price of the oil being in the neighborhood of 125 dollars per gallon. The other fatty oils in general, such as olive oil, cottonseed oil, and so on, are, as prepared at the present time, objectionable on the grounds of chemical instability, corrosive action on metals, and the relatively high temperature—not much below 0 degrees, Centigrade—at which they solidify. The petroleum oils are open to the objection that they have a tendency to escape from the bearings by spreading out over the plates and bridges of the timepiece. They are also less effective in reducing friction than fatty oils under conditions such as those encountered in timepieces.

In co-operation with the Clock Manufacturers Association of America, chemists of the United States Bureau of Standards have been investigating the lubrication of delicate mechanisms, such as clocks and watches, aeronautical instruments, and so forth. The importance of this subject has increased greatly with the increase in number and diversity of these instruments. Many are ruined and much money is lost by unsatisfactory lubrication.

Chemists hope either to prepare a very pure grade of vegetable oil, treated to insure its stability or else to produce a new synthetic oil free from the limitations of natural oils.—*A. E. B.*

Outboard Motor Digs a Cistern

THE outboard motor has proved to be a handy contrivance for a great variety of odd jobs. The latest application to which it has been put is to dig cisterns.

Cottagers and resorters dwelling on the shores of lakes that are shallow have been experiencing much difficulty with mud and sediment in pumping their water supply from the lake, and to remedy this, one outboard owner conceived the idea of placing a cistern in the lake. A hole 20 feet in diameter and six feet deep to receive this cistern was dug by the wash from an outboard motor on a boat that was anchored securely. The cistern, holding about 1000 gallons of water was then rolled in place.

It is said that this cistern is proving very satisfactory and that in pumping water out of the cistern it is as clear as though pumped from a well. The cost of installation is considerably less than it would be to run a pipe line into deep water. Four cisterns have already been installed by this method in a lake in Lodi, California.

What Is Glass?

BY the latest view, glass is a liquid in trance!

Its three ingredients are lime, soda, and sand. According to George W. Morey, of the Carnegie Institution, these have a particularly low melting point when mixed in the right proportion, and when the melted materials cool to the "freezing" point, the mixture is so stiff that the molecular change which would cause the glass to become opaque can hardly take place. If the glass loses its transparency, something was wrong with the mixture.

In this respect, glass is a product peculiar to itself—there seems to be nothing else like it.—*A. E. B.*

Do the Tides Do This?

HERE is an experiment not mentioned in any of the scientific literature the editor has seen. If we carefully stand a rod of metal or any substance on end on a flat surface it will remain there until something topples it over. Such is ordinary experience.

Now suppose we extend the rod to several feet in height. As we do so, the difficulty of standing it on end in stable equilibrium will increase. This doubtless is due largely to the lack of rigidity of the rod. Suppose, however, we had an infinitely rigid, perfectly homogeneous, non-magnetic rod, perfectly straight, with a perfectly square end, stood on a perfectly level flat surface. Would such a rod remain in stable equilibrium if placed

The wash from an outboard motor on an anchored boat digs a hole in the lake bed to receive a cistern

within a larger tube (to keep off air currents) and protected from all shock?

This problem has been submitted by J. Ford Nelson of Greenfield, Massachusetts, who apparently has been experimenting.

The editor has not experimented on this problem—because, for one thing, a steady base or a steady anything is almost out of the question in New York, which shakes like jelly and quakes all day and all night. It is, however, believed that solar and lunar attraction would tip over the rod if it were high enough.

The next question is, who wants to stand a rod such as this on end, anyway, expecting it to "stay put?" Nevertheless the problem is interesting and scientific.

Water Purifier Prevents "Athlete's Foot"

A COMMON chemical, sodium hypochlorite, used in purifying city water supplies, has been found to be an effective preventive of ringworm infection of the feet by two Buffalo workers in medical research, Dr. Earl D. Osborne and Miss Blanche S. Hitchcock. This disease, also known as "athlete's foot" and similar nicknames, has spread spectacularly with the post-war rise of sports involving the use of common dressing-rooms and other gathering-places where athletes trample around barefooted for a time. There the spores of the fungi that cause the disease are spread from foot to foot, later causing acking of the skin, and itching, watery blisters.

Dr. Osborne and Miss Hitchcock state in their report to the official publication of the American Medical Association that they have not been able to find a record of sodium hypochlorite being used or suggested as a fungus-killer before. They made some preliminary trials with cultures of various fungi in test-tubes, using solutions of the chemical in concentrations stepped up from 0.001 percent to 0.5 percent. The latter concentration seemed the most effective, and was chosen as standard for a clinical trial.

With the co-operation of the physical training department of the Buffalo high schools, heavy rubber pans were installed in all the gymnasiums, and students going to and from gymnasium classes were required to wash their feet in a 0.5 percent solution of sodium hypochlorite. The solution was renewed every day. In a new high school a shallow "well" for the solution was built into the corridor passing from the dressing room to the showers. Later, the strength of the solution was increased to a full 1 percent because of possible dilution through use.

The results of the experiment are reported as most encouraging. The spread of the infection was completely checked. "Our records fail to show a single new case, although numerous ones have appeared from the surrounding towns," the two experimenters report.

The hypochlorite solution, however, is not to be looked upon as a cure for already established cases. The report continues: "So far as cure of the disease is concerned, we do not believe that 0.5 percent solution hypochlorite or even 10 percent sodium hypochlorite would be any more efficacious in curing an established case than any other methods employed at present in the

Over the extractor, on the floor above, is the door through which rubber scrap is introduced

treatment of this stubborn condition which troubles so many people."

The sodium hypochlorite treatment is the second efficacious prevention for ringworm of the feet reported recently. A short time ago Dr. W. L. Gould of Albany, N. Y., described how he had stopped the spread of the disease in the junior high school there with a 10 to 15 percent sodium thiosulphate solution used in a similar manner. The sodium thiosulphate solution is colorless and nearly odorless, so there is no objection to its use. If the bath is not convenient, a 20 percent powder of sodium thiosulphate in boric acid may be successfully used, Dr. Gould reported. This powder should be dusted lightly over the entire foot, between the toes and around the nails. It may also be used inside the shoes and stockings. A combination of bath and powder was reported as ideal at times.

Dr. Osborne and Miss Hitchcock, however, believe that their sodium hypochlorite solution offers certain advantages. It is cheaper, and when the quantities used in gymnasiums and similar places are considered this is a distinct advantage.—*Science Service.*

Rubber and Cotton Reclaimed From Tire Scraps

OF the contributions of chemistry to the every-day comfort and convenience of thousands of people, no example can be instanced more striking than the tremendous improvement in the quality of automobile tires during the last generation. One has only to recall the early days of the automobile when punctures were an accepted incident of nearly every ride to realize that our modern balloon type cord tires represent progress equal to that of the automobile itself. Most of the credit for better tires is due to the chemist, who is also largely responsible for the gradual reduction in the cost of pneumatic tires.

The modern tire could not be sold at present prices if the manufacturers did not practice every economy that science has been able to develop. One example of this fact is revealed in a recent paper by Charles S. Powell of the Firestone Tire and Rubber Company, who describes therein a newly developed process for salvaging the scraps of rubber and cotton which are trimmed from uncured tires during manufacture. The scraps consist of cotton cords embedded in uncured rubber. A thousand pounds of these trimmings are loaded into a revolving cage with walls of monel-metal screen. This cage rotates within a steel shell, which is then filled with benzene and the cage rotated for 2 hours, after which the benzene is drawn off, and fresh benzene added for another half-hour "washing." Six consecutive washes, the last two using hot benzene, dissolve out practically all the rubber, leaving clean, white cotton shreds. The cotton still contains some benzene, however, which is removed by turning steam into the extractor, driving out the benzene into condensers at the right of the extractor where it is recovered for use. The cotton is removed from the extractor, dried, shredded, and sold for paper manufacture or as a filler in cheap felt compositions; or, finely ground, it is sold as cotton floc.

The rubber extracted from the scrap remains in solution in the benzene—about a 6 percent solution. Fortunately, a solution of this kind is used in the tire factory for impregnating the fabric used in the manufacture, so the reclaimed rubber finds its way into a new tire after all.

Neither the cotton nor the rubber are deteriorated by this reclaiming process. One thousand pounds of scrap yield 1200 gallons of rubber solution and 400 pounds of cotton.—*A. E. B.*

Popular Misconceptions That Chemistry Corrects

WHY must blue overalls have threads with white centers? Why must they be a purplish instead of a true blue? Why does the housewife demand cloudy ammonia? Why is yellowish gasoline considered inferior? Why do people prefer blunt crystals of Epsom salts? These, says J. H. Collins, in *Chemistry and You*, are a few of the "trade customs" which cost business a great deal of money every year. Some of them were cunningly created, at some time, to deceive the buyer or the public.

Years ago, a clever dyer learned to save indigo by coloring the outside of the thread, and now the overalls buyer picks and unravels a thread to make sure the center is white—an imaginary test of quality. Natural indigo was impure, and gave a purplish tinge, which still stands for quality, though with modern dyes a perfect blue is easily obtained.

A British concern "put over" the idea that cloudiness stands for "strength" in household ammonia, and produced the cloudiness with a little palmitic acid.

Millions of dollars are spent making white gasoline, or imparting a gay color to the naturally yellowish gas, because the public firmly believes white gasoline better—which it is not.

Blunt crystal Epsom salts used to command a premium in the drug trade, for their supposed higher efficiency—highly efficient hunk.

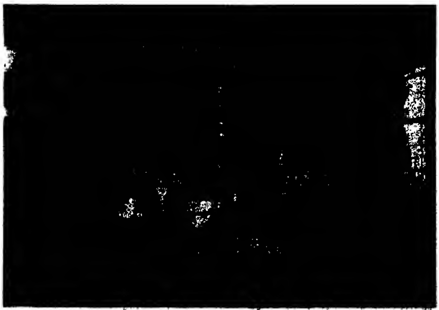
One of the commonest trade beliefs is that a tinge of color in chemicals indicates purity or strength. But such color is generally an impurity—in a word, dirt! At some time in the past, dirt could not be eradicated and so was made an imaginary mark of quality.

One eastern silk factory demands brown in its phosphate of soda solution, and another insists upon white, and both believe they are buying a pure article. But a brown tinge, in this chemical, is not an impurity, while chemical impurities likely to do damage to silk are colorless—and there you are!

Only the chemist can dispel such traditional beliefs by determining scientifically what is fiction, and what is fact.—*A. E. B.*

Whale Oil Food

IN the good old whaling days that sea captains like to talk about, whale oil was an illuminant. Now it is a food. Hydrogen gas is passed through it in the presence of nickel filings—a process of hydrogena-



Extractor used for removing the uncured rubber from tire scraps. The scrap rubber is charged from the floor above. The recovered, clean cotton is dumped, at the end of the process, into the bag which is shown beneath the extractor

tion. A rather cheap oil is thus converted into a more expensive hard fat. A good deal of the margarine that is sold outside of America is composed of this promoted whale oil.

The Uniclock

A CLOCK that makes the earth turn over —at least in replica—and which has been aptly characterized as "alive," will be of interest to amateur scientists, particularly amateur astronomers. It consists of a globe of the earth geared to an electric clock in such a manner that the globe keeps step with the earth's axial rotation. It is

The clock which turns a globe which is lighted from within to indicate illumination of the earth by the sun. The other half is dark

made by the Universal Clock and Globe Company of Wilmington, Delaware.

The globe is translucent and an electric lamp within it produces a contrasting light on its surface, showing as it rotates the position of the termination (sunrise and sunset) lines. In other words, one sees the clock as he would see the earth were he far out in space, or on the moon.

The lamp within the globe revolves once a year. Thus the illumination of the earth by the sun at the various seasons is duplicated and in this and other ways this earth clock is educational.

Boric Acid From Steam of Volcanoes

OVER in Italy, the raw material for one of the most unusual chemical industries comes from volcanoes: The Societa Boracifera manufactures boric acid from steam of volcanic origin (the so-called "soffioni," steam spouts) which arises naturally out of the earth but which, in much larger quantities and better condition for exploitation, is obtained from openings in the ground reaching a variable depth of more than 500 meters.

The volcanic vapor brings out the boric acid, ammonia, and other substances mixed (Please turn to page 347)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS month our space is devoted to the interesting work and discoveries of Mr. John H. Hindle, Director of the Union Engineering Works, Haslingden, Rossendale, Lancashire, England. Mr. Hindle

Hindle's compound reflector

; presses and heavy looms, but makes of telescope making an amateur hobby which amounts almost to an avocation. He is a "specialist" in the Cassegrainian and Gregorian—in fact, he is one of a very small number who really understand these types in theory and in practice. He occasionally visits this country and calls at these offices, and at our request he has prepared the following descriptive matter, first, concerning a 20½-inch Newtonian-Cassegrainian, then an enclosed polar observatory (photographs of both are shown), and finally his discovery of a new test for the Cassegrainian and Gregorian.

"THE mirror of the 20½-inch Newtonian-Cassegrainian shown above is mounted in a cast iron cell with adjustable edge supports and resting on a mechanical flotation system giving 18 equally loaded symmetrical points, emanating from three adjusting screws. The tube is of timber, built up on aluminium rings. The fine adjustment in declination is operated by a hand wheel and screw from the Newtonian end, and more slowly by means of an extension shaft operated through bevel gears, from the Cassegrain end. The polar axis and fork are cast in one piece, and rotate in ball bearings, the top ball-bearing housing being adjustable. The worm wheel is of large diameter and the worm is provided with slow motion gearing which operates by a hand rod and hook joint, while the clock is running. The drive is by gramophone motor.

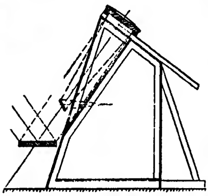
"The mirror is of 20.2 inches aperture, is of eight-foot focal length, and has a five-inch hole through the center. Interchangeable spiders for the top end of the tube carry, respectively, the diagonal plane mirror and the Cassegrain convex mirror. The latter is mounted in a cell, about six inches outside diameter, and provides an equivalent focal length of 30 feet.

"The performance of this telescope, which is shown in actual use, will probably be fully described in an astronomical journal by Dr. W. H. Steavenson, F. R. A. S., one of the foremost amateur observers in England, who has erected it in his observatory."

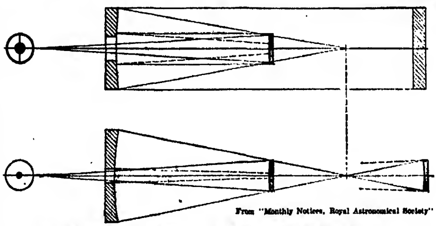
The advantage of an entirely enclosed observatory, which can be heated sufficiently for bodily comfort without spoiling the definition of the mirrors, has been somewhat extensively discussed in the book "Amateur Telescope Making," pages 50–51. Mr. Hindle is responsible for a particular type of polar observatory of which several illustrations are reproduced. One photograph reveals the interior, showing the comfortable method of observing.

"The actual site is N. latitude 53¾°," Mr. Hindle writes. "The primary mirror is paraboloidal, mounted in a cast iron cell, looking face downward from the top of the hut. Actually this mirror is a disk 25½ inches in diameter; the excavation being only 20 inches aperture and the outer flat portion providing a suitable support. The focal length is eight feet and the cone of rays is turned *horizontally* into the hut by means of a slightly elliptical mirror adjustably mounted in an 'A' bracket, which performs the function of the spider in the orthodox telescope tube. The only moving portion is the coelostat, which has a plane mirror of 25½ inches aperture, counterbalanced and pivoted on a surface diameter for declination, and re volving on a polar axis for right ascension.

"Electrically driven reversible speed motions are applied to declin



The enclosed observatory, with a sketch (above) showing the layout and, at right, Mr. Hindle observing



From "Monthly Notices, Royal Astronomical Society"

At top ("Figure 1"): the old Ritchey parallel ray test. Left to right: for correction; paraboloid; hyperboloidal convex; flat. At bottom: ("Figure 2") new Hindle spherical mirror test. Left to right: area visible for correction; spherical mirror; hyperboloid; ellipsoidal concave mirror (for a Gregorian)

and right ascension, controlled from inside the observatory. An additional elliptical flat, deflecting the rays directly from the coelostat, permits the use of a short finder telescope if required. (This flat shows in one of the photographs, below the bracket. —*Editor.*) A sextant with reading microscope is fixed on the declination axis, and the polar axis reads zero hour when pointing due south. A concrete foundation

The observatory when closed

about a foot thick supports the entire observatory, which is very rigidly constructed and braced, two light I-section beams being provided for sliding the primary mirror up or down in its cell.

"The adjustment of the mirrors to the polar axis is facilitated considerably by the optical combinations that can be obtained in a very interesting manner. The construction of the hut itself insures that the primary mirror and elliptical flat roughly approximate to the polar angle. They are set optically in line with each other, after which the coelostat mirror is moved in declination until it is precisely parallel with the parabolic mirror, which can be observed from the eye position. It is now rotated in R. A. and if the parallelism is lost, then the coelostat base (and polar axis) is adjusted by the base screws until parallelism with rotation are secured. The three mirrors are now on one optical axis and the sextant is set to read 90°. The coelostat mirror, at zero hour R. A., is now brought perfectly level, and the sextant should read $180 - 2 \times$ latitude; in this instance $180 - 107\frac{1}{2} = 72\frac{1}{2}°$ from the pole, or $17\frac{1}{2}°$ N. declination.

"In case of an error a fresh optical axis nearer the correct position is selected for the first two mirrors, and the coelostat adjustments repeated. If an inclinometer is available, then the angle can be tested right away when the two large mirrors are parallel with each other.

"Silvering the mirrors need not upset adjustment. The coelostat mirror is readily replaced in the same plane. The other two are removed one at a time, and each brought to a correct position by reference to the other. The adjustment to the meridian is checked by the southing of some prominent object at the precise moment indicated in the N. A."

WELL, how many of you amateurs are now going to make a Hindle comfort coop for cozy constellation conning? No frozen fingers, no summer mosquitoes to slap and cuss at. It looks mighty good to ye ed.—and inexpensive, too. In Yankee (*Please turn to page 355*).

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

LIGHT ON AN IMPORTANT SUBJECT describes an invention born of necessity for lighting book stacks without giving attendants unnecessary glare. It was developed for the great Sterling Memorial Library of Yale University. *Snead & Company, Jersey City, N. J.—Gratis.*

SEEING IS BELIEVING is a beautifully printed brochure intended to help a campaign to lengthen life. The story is told in pictures. It is issued by the Welfare Division of the *Metropolitan Life Insurance Company, New York, N. Y.—Gratis.*

TESTING OF TIMEPIECES (Bureau of Standards, Circular No. 392) describes the interesting work carried on in testing watches and chronometers. The directions for handling watches are excellent and should be in the hands of every one who has a regard for correct time. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

AERONAUTICS TRADE DIRECTORY (Aeronautics Bulletin No. 3) is a publication giving a list of aircraft manufacturers, makers of supplies of every description and sundries. There is also a list of air transport operators, aerial surveyors, and those furnishing aeronautical instruction. We even find that there are "consulting meteorologists." *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

THE WORKING OF SEMI-PRECIOUS STONES by J. H. Howard is a brief elementary monograph on the lapidary art. The literature on this subject is so extremely limited that a pamphlet for amateurs written by an amateur will be appreciated by many home mechanics. There are a number of excellent illustrations. *Rocks and Minerals, Poughkeepsie, N. Y.—$1.00.*

DISEASES IN CAPTIVE WILD MAMMALS AND BIRDS by Dr. Herbert Fox, pathologist of the Philadelphia Zoological Society and Curator of Pathology is a unique publication containing practical discussions of the effect of diseases, growth, and development of captive wild animals and their relations to man. It contains nearly 700 pages. *Dr. H. L. Ratcliffe, Zoological Garden, Philadelphia, Pa.—$15.00.*

CARPET WEAR TESTING MACHINE (Research Paper, No. 315 Bureau of Standards, Reprint from *Bureau of Standards Journal of Research* Vol. 6, June, 1931) by H. F. Schiefer and A. S. Best describes one of the curious machines designed at the Bureau of Standards; the machine reproduces the bending, slipping, twisting, and compression of the pile which takes place when the carpet is walked upon. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

A YEAR-BOOK OF RAILROAD INFORMATION, 1931 EDITION gives a vast quantity of information in graphic form and in small compass. It shows the wonderful service rendered to the public and what it costs. *Committee on Public Relations of The Eastern Railroads, 143 Liberty Street, New York, N. Y.—Gratis.*

RADIO TUBE DATA is a 32-page loose-leaf pocket-size booklet on radio receiving tubes and presents over 80 graphs giving static and dynamic characteristics of all types of receiving tubes. The information is presented in the well-known "Lefax" form. *Lefax Inc., 9th and Sansom Sts., Philadelphia, Pa.—$1.00.*

SLASH PINE (Farmer's Bulletin, 1256-F, Department of Agriculture) deals with information useful to the grower. This tree produces the heaviest crops of naval stores and also produces valuable timber. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

FOREST TYPES IN THE SOUTHWEST AS DETERMINED BY CLIMATE AND SOIL (Technical Bulletin, No. 247, U. S. Department of Agriculture) by G. A. Pearson. No other form of agriculture is so completely subject to the forces of nature as is the growing of timber crops. Forest meteorology in this country is still in its infancy. Soil surveys such as are made in agricultural sections are not adapted to forest land. The investigations outline the problem and how it can be solved. *Superintendent of Documents, Washington, D. C.—30 cents (coin or money order).*

TESTS OF WELDED BOILER DRUMS (Reprint from *Combustion*, November, 1930) is a valuable article, for with the rise in steam pressures the fusion welding process appears to be the most practical for boiler drums. The results are described in this article. *Combustion Engineering Corporation, 200 Madison Avenue, New York, N. Y.—Gratis.*

INDUSTRIAL RESEARCH METHODS AND WORKERS (Reprint, *Journal of Engineering Education*, Volume XXI, No. 2) by Edward R. Weidlein, the Director of the Mellon Institute, describes how co-operative research is carried on. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

BUDGETARY CONTROL IN MANUFACTURING INDUSTRY is based on a survey of 288 highly-rated manufacturing companies and gives the facts concerning the operation and effectiveness of budgeting in manufacturing industry, citing the methods used and the results secured. After all budgeting is only careful planning. It is a book which should be in the hands of every major executive in American industry. *National Industrial Conference Board, 247 Park Ave., New York City.—$3.00.*

SNOW REMOVAL AND EQUIPMENT (Bulletin No. 20) gives a survey of needs for and availability of equipment. It gives the scientific and technical principles employed in snow removal. *American Road Builder's Association, Suite 938, National Press Building, Washington, D. C.—Gratis.*

WORKBOOK FOR USE WITH "THE SCIENCE OF EVERYDAY LIFE" by Edgar F. Van Buskirk and Edith Lillian Smith assisted by James R. Wilson is a kind of students note book. It is admirably prepared and is fully illustrated. Some of the subjects include: air, water, foods, forces of nature, homes and clothing, and work of the world. *Houghton Mifflin Company, Boston, Mass. —72 cents.*

OBJECTIVE TESTS IN GENERAL SCIENCE by James R. Wilson is based on the new edition of Van Buskirk and Smith's "The Science of Everyday Life." This ties in with the workbook mentioned above. *Houghton Mifflin Company, Boston, Mass. —24 cents.*

SOLVING FOOD MANUFACTURING PROBLEMS BY RESEARCH INSTITUTE METHODS (Reprinted from *Food Industries*, September 1930) by Lawrence W. Bass deals with the food problems worked out at Mellon Institute. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

CHEMICAL ECONOMICS (Reprinted from *Annual Survey of American Chemistry*, Volume V., 1931) by Lawrence W. Bass gives a review of American literature, 1925–1930 and cites 226 titles. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

HANDBOOK OF FIELD MUSEUM OF NATURAL HISTORY gives general information concerning the museum, its history, building exhibits, expeditions, endowments, and activities. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

PHYSICAL PROPERTIES OF EARTHS (Bulletin 101) by John H. Griffith presents a report of researches on the physical and chemical properties of loam, yellow clay, and blue clay. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE LARGEST STEAM GENERATING UNITS IN THE WORLD describes the three 800,000 pound units installed in the new extension to the East River Station of the New York Edison Company, which is costing 12,500,000 dollars exclusive of site. *Combustion Engineering Corporation, 200 Madison Ave., New York, N. Y.—Gratis.*

OFFICE OF EDUCATION DOLLAR PACKET OF DIRECTORIES is an economical way of buying lists of schools and school officials and is priced at or below the cost of production. *Superintendent of Documents, Washington, D. C.—$1.00 (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 343)

with carbon dioxide gas. From some openings in the earth is obtained the boric acid water, which is also taken from underground by simple means of removal of deposits, operated by the natural vapors.

The boric acid water is then concentrated by evaporation, and cooled, which (according to the extent of crystallization) varies from 98 percent to a minimum of 82 percent. The acid is then dried and shipped as raw, or refined and used for the manufacture of borax (adding carbonate of soda).

The ammonia contained in the vapor is placed, in convenient equipment, with sulfuric acid, obtaining ammonium sulfate which is purified and sold as talc, or decomposed in retorts with lime to use the ammonia in special chambers to produce, together with carbonic acid, the ammonium carbonate.

The carbonic acid, which is found in great quantities in the natural vapor, is used. It passes into a special section where it is dried and purified. It enters into the preparation of the ammonium carbonate, chiefly, it is liquefied and s... tles.

Other products of the Boracifera factory are sodium perborate and all the special salts which may be required.—*A. E. B.*

Uterine Cancer

DESPITE the fact that the cervix is easily accessible both to sight and touch, cancer in this location is usually in an advanced stage when first discovered. The subjective symptoms in early cervical carcinoma are vague or even absent and are not often recognized by the patient. Therefore, if cancer of the cervix is to be prevented and controlled, it will be neces... and periodic e... ...a of this organ.

As the majority of cervical cancer cases occur in women who have borne children, it is suggested that physicians should urge an annual or semi-annual examination of mothers to determine if there be any pathological condition of the cervix. Cancer rarely, if ever, occurs on a normal cervix. It is usually preceded by some chronic lesion and is often associated with tears sustained at childbirth.

Professor W. P. Graves, Harvard University, in a study of 500 cases of cervical cancer found that only 2 percent of the patients had had cervical repair, while, on the other hand, among nearly 5000 women who had received this treatment he found only six who had developed cancer.

The very early stage of carcinoma of the cervix cannot be definitely diagnosed clinically. In all suspicious lesions a biopsy should be employed at once. This is a safe and easy operation and does not require an anesthetic. A biopsy by a competent pathologist offers a quick and definite diagnosis.

Statistics show that 75 percent of early treated cases survive the five-year period while the salvage in advanced cases is comparatively small. Although the majority of cases of cervical cancer occur near the

menopause it must be borne in mind that this lesion frequently is found at a comparatively early age. There are on record at the State Institute for the Study of Malignant Diseases a number of cases in the early twenties and one case in a girl of eighteen who was married when she was fourteen and had borne two children.—*Health News*, New York State Department of Health.

Hot Steam for Cooling Trains

A NEW system of air conditioning and cooling for railway passenger trains, employing steam from the engine as the refrigerating energy and water as the sole refrigerating medium, thereby eliminating gaseous refrigerants, was recently announced by Willis H. Carrier, chairman of the Carrier Engineering Corporation. Mr. Carrier, who is also president of the American Society of Heating and Ventilating Engineers, designed the cooling system in the White House executive offices and the Capitol.

The new cooling system for railway cars is being demonstrated in an ordinary passenger coach enclosed in a building in which a temperature of 106 degrees and high relative humidity has been created. Within the car the temperature is maintained at 77 degrees, with corresponding moderation in the relative humidity. The test is purposely conducted under extraordinary conditions.

The elementary law of physics that water will boil or give off its heat at comparatively low temperatures when the atmospheric pressure is reduced, as in high altitudes, is the basis of the new refrigeration development. A tank partly filled with water is concealed at one end of the car. Steam drawn from the engine is forced under pressure past an opening in the upper part of the tank, thereby creating a vacuum within, and causing the water in the lower half of the tank to boil at about 50 degrees. In boiling the water gives off heat in the form of vapor which is drawn out of the tank by the suction of the steam, and results in lowering the temperature of the remaining water still further to about 40 degrees.

This cold water is then circulated through coils concealed in the roof of the car. Air is then drawn over these cooling coils, where it is cooled and de-humidified, and thence circulated throughout the car by ducts. From the cooling coils, where it acquired heat in cooling the air, the water is returned to the tank. The portion of the water that had been vaporized passes through condensing coils and is likewise returned to the tank. The whole cycle is repeated, the system being almost completely automatic.

The fact that steam is used to refrigerate the water eliminates the necessity for providing considerable extra electric power for the operation of a refrigerating machine as has been the case with previous systems. Other advantages include lighter weight and less space occupied, as well as low maintenance cost. The use of the existing source of electric current on a train for operation of fans and pumps eliminates the difficult problem of finding a large additional and continuous source of power. Engineers believe the new development foreshadows general application of air conditioning and cooling on American railroads.

Approximately 2000 cubic feet of conditioned air per minute is provided for in each car, affording a complete change of air every minute. The refrigeration capacity in each car is equivalent to about five tons of melting ice per 24-hour period.

Co-operating with the Carrier Engineering Corporation are the Safety Car Lighting and Heating Company of New York and the Silica-Gel Corporation of Baltimore who will be associated in the development and introduction of systems of air conditioning for railway service.

Synthetic Hydrocarbons

CHEMISTS have long known that methane can easily be formed from carbon monoxide and hydrogen, by passing a mixture of these gases over a suitable catalyst at atmospheric pressure and at temperatures as low as 150 degrees, Centigrade. It is only in comparatively recent years, however, that appreciable quantities of higher members of the methane series have been prepared by similar methods from carbon monoxide and hydrogen. Consideration of the hypothetical reactions involved show that thermodynamically the formation of higher hydrocarbons from carbon monoxide and hydrogen should proceed

A government contract has been awarded for the construction of the largest and most complete laboratory for research on wood. In the new building, located at Madison, Wisconsin, the Forest Products Laboratory will continue their work, initiated 21 years ago, to improve the production and broaden the uses of all classes of forest materials. The building will be equipped with all modern scientific and technical facilities to expedite their operations

with greater ease than the formation of methane and that the maximum possible yields are greater.

An exhaustive investigation of this process has been conducted on a small scale at the Pittsburgh Experiment Station of the United States Bureau of Mines, regarding optimum operating conditions, choice of catalysts, and conditions which control yields. In this work it has been demonstrated that the extent of the conversion of water gas to hydrocarbons can be made fairly high; and that the process can be so conducted that the major portion of the yield will be products which are liquids under ordinary atmospheric conditions. With favorable catalysts, 30 percent conversions have been effected with one pass through the converter.

The liquid portion of the product comprises 60 to 75 percent of the total organic products; methane appears as a minor constituent. The liquid product consists mostly of hydrocarbons of the methane series, having only traces of compounds containing oxygen.

Thus it has been demonstrated that a synthetic product resembling petroleum can be obtained from water gas. This fact may in the future cause this process to assume considerable importance as an auxiliary source of liquid fuel, and may offer to the manufactured-gas industry at the pre

and odori

gas.—*A. E. B.*

200,000 Amperes on Rampage

PRACTICALLY everyone has noticed the attraction and repulsion between o little horseshoe magnets, but few people realize the tremendous mechanical

Courtesy Westinghouse Elec. & Mfg. Co.

Cables carrying 200,000 amperes broke their fastenings like twine

forces exerted on modern electrical equipment when it is carrying a large current, and setting up a strong magnetic field.

In a recent test, 200,000 amperes of alternating current was passed through a piece of electrical apparatus. Although the apparatus stood this flood of current, the power leads, as thick as a man's wrist, broke their two-inch* rope lashings, and writhed like monster reptiles in agony.

Although the two 1⅛" diameter cables were kept two inches apart and tied down every few inches with heavy rope, a litt figuring made it clear why the rope gave way like so much twine. It was found that the force between the cables reach value of 10,000 pounds for every foo cables were tied together. Not only but the force was pulsating at the ra

Where the lashings did not break, they bit deeply into the insulation

120 times per second; that is, the force reached a maximum and dropped to zero 100 times in the duration of a heart beat.

When such a striking demonstration of mechanical forces produced by electrical currents has been witnessed, one obtains some conception of the skill necessary in the design of large and complicated electrical machines which must withstand many

machinery, was conducted from a safely

endangered by the breaking loose of the cables.

*Many persons, reading in sea stories of 10-inch and 12-inch hawsers, do not realize that the size of a rope is designated by the circum

Typhoid Fever

THE marked reduction in the prevalence of typhoid fever throughout the United States has been one of the outstanding accomplishments in public health during the past quarter of a century. This has been accomplished in cities where the sources of public water supply are grossly polluted, and in such cases it has been done largely by the intelligent installation of approved water purification plants. However, although the purified public drinking water meets the accepted sanitary standards, there often persists in such cities a small number of cases of typhoid fev

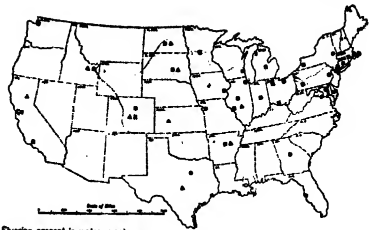
United Stat

Public Health Servic

tudy of these persisting or residual cases of typhoid fever, the object being to determine whether they bear any relation to the municipal drinking water even though it did meet the present rigid sanitary standards.

Six cities situated on the Ohio River were selected for study, both because of the polluted character of their raw water supplies and because of the excellence of their municipal water purification plants.

The Ohio River is the source of the public water supply for each city. During the period of raw water consumption, the typhoid fever incidence in each city was uniformly very high in every month of the year—a seasonal distribution which is typical of endemic water-borne typhoid fever. Following the installation of the present public water supplies, the typhoid



• Fluorine present in water supply.
• Fluorine absent from water supply.
• Dental defects known to occur.

Map showing relation between dental defects and fluorine in water supply

incidence promptly fell to a low rate comparable with rates prevailing in other cities on the Ohio River watershed which have had, at least since 1914, safe water supplies. At the same time, the seasonal distribution changed so as to give a definitely summer and fall disease.

Ample evidence accumulated to indicate that routes of transmission of typhoid fever other than the public water supply were in all probability the more usual.

Therefore, the conclusion was reached from the evidence collected that modern

operation in the six cities studied, when properly operated and controlled, effectively eliminate the danger of contracting typhoid fever from the public drinking water, even though the raw water supply be grossly polluted.

Disfigurement of Children's Teeth

FOR 30 years dentists and chemists throughout the world have sought the cause of a disfigurement of children's teeth known as "mottled enamel," but the answer in the one word, "fluorides," came from an industrial chemist, H. V. Churchill, as part of the daily work in an industrial research laboratory.

"Mottled enamel" gives the teeth a dead-white opacity, often stained in disagreeable patches of brown or black. The stains may be accentuated by a corroded appearance of the surface, as if it had been eaten by a harsh acid. The enamel is damaged in its formation on the permanent teeth before they emerge from the gums. Thus only children are victims; the permanent teeth come in, pitifully marred in appearance, although normal in shape. The unfortunate ones so marked are marked for life; no bleaching or abrasion will correct the defect.

Children in widely scattered but well-defined localities are affected and in recent years prominent authorities have blamed some impurity in drinking water as the cause, although unable to determine just which one of the score of water-impurities was harmful. No two localities, it seemed, had drinking water characterized by any mutual abnormality, but nevertheless all evidence pointed to drinking-water as the cause.

Mr. Churchill is no specialist in public health, being Chief Chemist in the research organization of the Aluminum Company of America. In this particular case, Dr. F. C. Frary, Director of Research, had noted mottled enamel among the children of employees at Bauxite, Arkansas, an "aluminum" town where exceptionally pure water was obtained from deep driven wells. At the first intimations that this dental scourge was due to drinking water, the wells

r from a distant river. At this time Mr. Churchill attacked his problem of exploratory investigation.

By means of a spectograph, he identified fluorine among the elements present in each sample of harmful water—fluorine, with a "criminal" record among elements as a ravisher of living tissues and a disrupter of normal bone structure.

Although the presence of fluorine had been recognized in certain mineral waters, no one had previously considered the likelihood of fluorides being among the impurities of any ordinary drinking waters. In none of the standard published methods of water analysis is mention made of fluorine content or determination. Fluorides had always been dismissed as non-existent in community water supplies.

Churchill's search for fluorine was based on published records of its harmful effects and on a memory of investigations by Schwyzer. He recalled that about 25 years ago brewers had adopted the use of a calcium fluoride solution to sterilize beer vats because this solution killed wild yeast without harming the cultured varieties. Drinkers of this beer became afflicted with a peculiar bone trouble that was identified as a result of consuming small amounts of the fluoride solution, and the dismayed brewers abruptly ceased its use.

It is held that a daily dose of one milligram of fluorine—about one thirty-thousandth of an ounce—will cause serious systematic disorders.

The revelation that fluorine in drinking water is responsible for the permanent disfigurement of thousands of children imposes a new duty on those who are responsible for the quality of water supplies. Hitherto processes of chlorination and clarification

have been deemed sufficient in water purification but now an additional control is necessary. Chlorination solved the problem of typhoid. The control of fluorine concentration so that it never exceeds one part per million will solve this age-old problem of mottled enamel.

Invisible Riches

RESEARCH is being conducted at the Montana School of Mines to harden gold, silver, and platinum so that almost invisible filigrees of these precious metals —yet strong enough to support great clusters of jewels—may be produced.

Hot Bearing Indicator

A PORTABLE indicating pyrometer, recently developed and placed on the market by Illinois Testing Laboratories, Inc., Chicago, is now being used in detecting hot bearings on locomotives and rolling stock, as well as for a number of other purposes in railway service.

This instrument, called the Pyro Prod, consists of a highly sensitive yet rugged milli-voltmeter, to which is attached a pair of pointed thermocouple wires. When the points of these wires are pressed against the bearing, the bearing metal completes the circuit and this causes a small flow of electric current to the indicator. This flow of current increases with the increase of temperature and causes the pointer of the milli-voltmeter to deflect over a scale which is graduated in degrees Fahrenheit. Almost instant readings are obtainable, as it is merely necessary to make contacts betw the pointed thermocouple wires.

The Pyro Prod can be furnished in several different temperature ranges, but the one most generally used for bearing work is from 0 to 600° Fahrenheit. When desired, the Pyro Prod is furnished with an automatic internal cold-end compensator. This is important where the instrument is to be used out-of-doors and subject to wide changes of atmospheric temperature. Other models of contact-type pyrometers can also be furnished for measuring the surface

Convenient and accurate indicating pyrometer used to show the temperature of a bearing

temperature of other metals such as heated billets, rods, and rails.

When used on locomotives, the Pyro Prod is carried in the cab and at each stop the engineman takes the instrument and goes from one bearing of the locomotive and tender to another, quickly checking the temperatures, and eliminating all guesswork as to whether or not excessive temperatures are being developed, with consequent possibility of train delay. The instrument also has other industrial uses. —*Railway Age.*

Pink Lemons Discovered

However, the tree is a rare specimen and the United States Department of Agriculture warns that there is little chance of the pink lemonade industry switching to the new lemons for raw material.

Pink lemons were first exhibited at the National Orange Show this year. They came from a tree in Burbank and, so far as known, the tree is a bud sport (or freak) of the Variegated Eureka lemon, which was developed from a limb variation of the Eureka lemon, discovered in 1911. The Variegated Eureka lemon trees are not as productive as the normal Eureka lemon trees and they are grown chiefly for ornamental purposes.

The pink fruited lemon tree is identical in appearance to the Variegated Eureka tree, but as the fruit approaches ripeness it develops a decidedly pink color in the rind, flesh, and juice.

Budwood from the pink lemon tree has been inserted in sour orange seedlings and the resulting trees will be studied to see if the pink lemon can be further propagated. Department specialists declare the pink lemon is another illustration of the occurrence of striking bud variations in this variety of citrus fruit

Chemist's Suggestion Aids Cancer Research

A PRELIMINARY report on the results of experiments during the last two and one half years with a new lead solution for the treatment of certain types of cancer, which may mark an important advance in cancer research, was recently announced in the *American Journal of Cancer* by Dr. William H. Kraemer of the Tumor Clinic of the Jefferson Hospital, Philadelphia. The announcement must not be considered, in any sense, as a "cure" for cancer—it is merely a development which seems to make a previously-known treatment appear to promise to be more practical at some later date. A cure is far from available at present.

In 1925, Professor W. Blair Bell of the

University of Liverpool, England, announced his discovery that the injection of colloidal lead into the blood stream of cancer patients seemed in some cases to give some relief. However, the injection of lead is extremely dangerous.

More recently, an American chemist, Dr. Hamilton Bradshaw of the duPont Company, becoming interested in the chemistry of this treatment, suggested that the toxic effect of lead might be reduced if small amounts of manganese phosphate were incorporated.

Dr. Kraemer's report sets forth that by adding a one-hundredth part of manganese to each part of lead used in the solution, and injecting the solution intravenously in animals, "no ill effects were encountered."

"As a method of treatment," Dr. Kraemer asserts, "the advantage of lead phosphate with manganese over lead phosphate without manganese is obvious. With the latter about four months is required to introduce the full dose of 600 milligrams, while with the former only six days is required. The toxicity of lead phosphate is injurious to the patient's health, while the absence of toxicity of the new preparation permits its use in all post-operative cases preceding radiation.

"The outstanding feature of the new lead-manganese preparation is that it is well tolerated by the patient, enabling us to introduce intravenously 100 milligrams daily until the total of 600 milligrams is reached."—*A. E. B.*

Aphids Move Abdomens to Frighten Enemies

WHEN aphids, or plant lice, line up on the stem of a plant and bury their beaks in the tissues to suck sap they move their abdomens up and down and from side to side in unison, like a battery of animated bellows. Some observers have suggested that the aphids used their abdomens to pump the juices from the plant, but Dr. Floyd F. Smith, entomologist of the United States Department of Agriculture, believes they move in this manner to shake off or frighten away their enemies.

On the approach of danger or the occurrence of a slight mechanical disturbance, such as jarring, the aphid twitches its abdomen without withdrawing its beak, Doctor Smith says. This is a reaction to danger from small parasitic flies or wasps attempting to lay eggs on or within the aphid's body. When the first aphid twitches, it startles the next one. Thus a wave of twitching moves along the line of insects.

Doctor Smith has observed that this twitching is not essential to sucking, for some species of aphids do not twitch, and yet they seem to feed as much and to propagate as rapidly as others. Delicate muscles within the insect's head enable it to extract the plant sap, he says, and apparently the abdomen does not function as a bellows.

Making Hay Without the Sunshine

ANOTHER of the sun's steady jobs has been taken away, and another agricultural proverb has been proved out of date, at E. A. Ashton's Ashgrove Farms, near Saratoga, New York. Making hay whether the sun shines or not is something that the Ashgrove Farms have been doing profitably since last June with the aid of an artificial dryer and electric motors.

Experiments in the artificial drying of hay have been carried on for some time with electrically-driven machines known as "Ardryers" for curing hay crops regardless of prevailing weather conditions. The "Ardryer" is a product of the Arnold Dryer Company, of Milwaukee. The installation of one of these machines at the Ashgrove Farms is one of the latest and most successful of these applications, and aroused considerable interest among summer visitors in upstate New York.

This has been an exceptionally bad year for forage crops because of the excessive rainfall, but Mr. Ashton has stored in his barns about 600 tons of dried alfalfa and mixed hay of high quality, and it would seem that a fickle sun has been successfully flouted. It has been estimated that about one half of the crop would have been lost, or of poor quality, had sun-curing been relied upon.

The artificially dried hay is highly nutritious because the leaves, which become wet with rain and are easily lost in sun curing, are saved. The crop as a whole is higher in protein and fat values and lower in fiber content. After drying, the hay can be stored

The hay cutter that feeds the Ardrier, which cures hay without sunshine

An Ardrier installation in use in the field

indefinitely without heating, sweating, fermenting, or discoloring. The dried hay retains its natural green color.

The bale of hay also has passed from the picture at the Ashgrove Farms. The hay is first delivered to a cutter, driven by a General Electric 20-horsepower motor, where it is chopped into fine pieces—suitable for later automatic handling but forever out of the province of the baler. The amount of moisture in the crop offers no difficulty. The chopped hay is fed from the cutter to a revolving cylinder, seven feet in diameter and 20 feet long. At one end of this drum is an oil furnace and the hay and hot air are drawn through the cylinder, or dryer, by an exhaust fan located at the outlet end. The dried hay is then delivered to a collector from which it is fed to a blower and blown directly into the mow in the barn. The cylinder of the dryer and the blower are driven by General Electric motors of 25 and 10 horsepower respectively.

Mr. Ashton has estimated that the cost of his summer crop of hay was no greater because of the artificial drying process, the crop itself was of higher quality and feed value, and all the losses usually following a rainy season were eliminated.

Belgium's Nickel Coinage System

WITH the issuance of a 20-franc coin in pure nickel, Belgium now has the most complete nickel coinage system of any country in the world. It has nine different nickel coins, six in pure nickel—in denominations of 50 centimes, 1, 2, 5, 10, and 20 francs—and three of essentially the same copper-nickel alloy as the United States five-cent piece—in denominations of 5, 10, and 25 centimes.

The first 20-franc coin was recently executed by the Hotel des Monnaies, was approved by the Commission Monetaire and placed in circulation through the Banque Nationale.

Approximately 3,000,000,000 pure nickel coins have been issued in 64 denominations by 24 countries.

Smoke Damage in Chicago

SMOKE from burning coal costs the people of Chicago 95 dollars per minute, according to estimates of Joseph Harrington, who served as administrative engineer of the United States Fuel Board in Illinois. In a recent address Mr. Harrington said that burning of smokeless fuel, such as gas, would effect an annual saving of 50,000,000 dollars in that city. His figures exclude cleaning smoke-soiled house furnishings, and do not include injury to health by smoke laden air, he said.—*A. E. B.*

Marine Algae as Fertilizer

THE Governor of Tripolitania has had a chemical investigation made of algae which form large deposits at many parts of the coast of Tripoli, to find out whether they have fertilizer possibilities after having been first used as bedding for cattle. The analysis shows: water, 19.44 percent; nitrogen-bearing materials, 2.4 percent; carbohydrates, 51.86 percent; chlorine as sodium chloride, 14.81 percent; lime, silica, soda, magnesia, alumina, iron, potassium, iodine, phosphate, and sulfate, 11.45 percent. The organic matter contains 3.85 grams of nitrogen per kilogram of algae. It would therefore seem to be possible to utilize the algae as fertilizer.—*A. E. B.*

A "Mike" for the Lapel

ENGINEERS have devised a microphone so small that it can be worn in the lapel of a coat or kept entirely concealed in the breast pocket. Using this miniature transmitter, a speaker can move about the platform as he pleases and continue to project his voice out over the loud speakers of the public address system. With the familiar stationary microphone, he has been obliged to take up a fixed position immediately behind it so that it would pick up his words effectively.

The lapel microphone is connected to its amplifier by a pair of flexible conductors which the speaker trails with him as he moves. All he requires in order to have the freedom of even the largest stage or platform is a sufficient length of wire.

In developing this system for the Western Electric Company, engineers of the Bell Telephone Laboratories took a new type of telephone transmitter which is just coming into use by switchboard operators and placed it in a mounting for mechanical protection. To cut down the rumble of a speaker's chest sounds, they provided a circuit containing an electric filter arranged so as to give a pleasing balance of sounds.

The tiny microphone has already been used on a number of occasions by Sergius P. Grace, well-known lecturer on the scientific marvels of the telephone. Mr. Grace hides the microphone in his breast pocket. The wires connecting it to the amplifier are covered with black silk and he passes them down the inside of his trouser leg. His audience, looking in vain for the microphone which is usually quite conspicuous,

is mystified as to how Mr. Grace's voice comes through the public address system. The mystification increases as he walks about the stage without interfering with the steady amplification of his voice. Ordinarily, at the close of his lecture, Mr. Grace takes the tiny microphone from his pocket and explains.

Automatic Electric Iron

SEVERAL distinctive features have been developed in the construction of a new iron made by the Crosley Radio Corporation and called the Moto-Iron. The ironing

Above: The Moto-Iron in use, patting out wrinkles. *Right:* A close-up of the mechanism of the iron

pad is vibrated by a small electric motor which pats out the wrinkles in the fabric, ... ntrast with the crushing effect of other irons. This results in a new, fluffy finish, even on rayons.

Using the Moto-Iron it is possible for the operator to sit in a natural position. Exertion of pressure is not required. The material is always in plain view and manipulation of controls is practically eliminated. As a result, the work is much less tiring. There is said to be no possibility of tearing material or breaking buttons when the Moto-Iron is used.

The new iron is small in size and is very simple and easily operated. It ... placed on any convenient table when ironing, and stored in a closet or cupboard when not in use. It is so light in weight that it can be carried from room to room.

Dairyman Turns Epidemiologist

A FAMILY residing at Glenarm, Illinois, made some ice cream for the family ... a few invited guests. Cows owned by the family were the source of the milk and cream used. Every member of the party who ate of the ice cream later became ill. None of the few who did not partake of it suffered an attack. Manifestly the ice cream carried the cause of illness.

The herd owner immediately withdrew from the market all of the milk produced by his herd. He took samples of milk from each of the eight cows and carefully labeled each sample. He collected the remainder of a can of pineapple, a part of which had been used for flavoring the ice cream, a sample of the ice cream itself, the freezer, the scoop, and a sample of water from the family supply. All of this material was brought in good condition to the diagnostic laboratories of the Illinois State Department of Public Health for examination.

This voluntary action on the part of the herd owner is highly commendable and indicates a much wider and a much more intelligent appreciation of preventive medicine and the methods of its practical application than is usually believed to be the case.—Abstract from the *Illinois Health Messenger* in *Health News* (Albany, N. Y.).

Overheating Causes Fuel Loss

SCIENTISTS have shown us that overheating the home makes us susceptible to colds and other illnesses, but now the heating engineer has translated overheating into dollars and cents. A recent study of the problem revealed that every degree of heat above 70 in the home represents a

waste of 3 percent in the fuel c...med. In other words, if the indoor temperatur ... 75 degrees, you are wasting 15 percent of the total fuel being consumed. From 68 to 70 degrees has been established as the most healthful as well as the most economical indoor temperature.—*A. E. B.*

No Depression in the Tungsten Tool Business

ONE industry that showed a gain during 1930 was the manufacture of tungsten carbide tools, which are made in the United States under several different names, according to the United States Bureau of Mines. These tools have shown such great efficiency in various types of work that the demand for them has grown despite the fact that the price for the compound is one dollar per gram—one and one half times the value of gold. Only a comparatively small tip of the precious metal is brazed on a tool.

Another surprising item of the tungsten business is that between 300,000 and 350,000 pounds of tungsten is used annually in alloys which are welded electrically to the edges of oil-well bits, giving them, in some rocks, a life ten or more times as long between dressings as the plain steel bits.

However, as much the greater part of the tungsten ore and concentrates produced in and imported into the United

States is used in the manufacture of high-speed tool steel, the consumption of tungsten, and usually the production, fluctuates with the rise and fall in operations in the steel industry. In the United States one short ton of tungsten concentrates is used for each 13,700 long tons of steel ingots and castings made. Therefore, the decrease of 28 percent in the production of steel in the United States in 1930 was reflected in the tungsten production in 1930.—*A. E. B.*

THE AMATEUR ASTRONOMER

(*Continued from page* 345)

latitudes the southern face of the hut will be raked back at a lower angle—just the thing, for this will provide more room at the bottom to sprawl out long legs and big feet in comfort. A fellow ought to be really comfortable in this kind of observatory.

Next comes Mr. Hindle's third contribution, a brand new test for the Cassegrain (and Gregorian, too). This is being tried out at Mount Wilson and may be used on the 200-inch. We quote verbatim Mr. Hindle's explanation of the discovery, as transmitted to the Royal Astronomical Society and published in the *Monthly Notices* (March, 1931) of that distinguished body, of which he is a member.

"The figuring of the secondary mirrors for compound reflectors has always been considered a difficult problem. The comparatively recent revival of the Cassegrain is undoubtedly due to the 'parallel ray' system of testing adopted by Professor Ritchey, and illustrated and described on page 39 of his work, 'The Modern Reflecting Telescope.' It may be noted that the concave secondary mirror for a Gregorian can equally well be tested by the same method (see Figure 1).

"That test leaves much to be desired. No matter how carefully the mirrors are collimated, the convex does not appear a perfect surface of revolution when examined under the knife-edge, probably because the illuminated pin-hole and the eye cannot simultaneously be on the optical axis. There is a large blind spot in the center of the convex, due to its interposition in the parallel rays returning from the plane mirror. The area visible is that due to point illumination only. The supports for the convex obstruct the view to some extent, in addition to which there are diffraction effects around all obstructions. The plane mirror used must be at least as large as the paraboloid, and requires first a spherical mirror from which it is derived with diminished accuracy. The five reflections are objectionable; to a certain extent they drown that figure of the secondary mirror which we wish to see.

"By the remarkably simple device of substituting a slightly larger *spherical* mirror in place of the *paraboloid*, with a radius of curvature approximately equal to the focal length of the latter (Figure 2), we immediately *dispense with the parallel rays*, and *reduce the number of reflections to three*. The secondary mirror is then seen under the shadow test in no uncertain manner. It can be correctly figured over a larger diameter. The blind spot in the center is much smaller, and the supports for the secondary mirror do not obstruct the view. Diffraction effects are therefore negligible.

"The circles to the left of Figures 1 and 2 show respectively the appearance of the small mirrors from the secondary focus.

"The mirrors are set up at approximately the required distance apart and squarely facing each other by reflection. The exact value of the radius of curvature of the spherical mirror is not of any importance: it is only necessary that its center of curvature and the shorter conjugate focus of the secondary mirror should coincide when testing.

"If the image of the pin-hole is examined with an eyepiece before the secondary mirror is corrected, there is such a considerable difference of focus that two distinct images may be found along the line of aberration, with much dispersion of light. When the secondary is correctly figured to look perfectly flat, all the light is concentrated within the image of the pin-hole, the details of which are plainly visible. The expansion of the image is the same on both sides of focus: in fact, the test is precisely similar to that of a spherical mirror at its center of curvature. It therefore follows that the surface of the secondary mirror *must* be accurate to within a very small fraction of a wavelength.

"It is obviously better to refer secondary mirrors to a spherical mirror, whose accuracy can be tested at any time by visual inspection, rather than to a combination of mirrors derived from the same source, with diminishing accuracy. It is likewise of the utmost importance to be able to produce secondary mirrors without reference to the paraboloidal mirrors with which they have to work.

"The uncorrected secondary mirrors for Cassegrain and Gregorian telescopes show diametrically opposite appearances under the knife-edged test. The former has a protuberant, the latter a depressed intermediate zone, at the average focus. The hyperboloid is therefore more difficult to produce, having a depression in the convex spherical surface, reaching a maximum depth at the intermediate zone, and diminishing to nothing at the edges and center. A corrected convex, if resting inside a concave spherical surface of suitable curvature, would make contact on the edge and center only. Such a figure cannot be produced haphazard, and if the depressed zone is unsymmetrical, an astigmatic image results.

"The Gregorian concave, like the paraboloid, is corrected by excavating the center more deeply, the excavation diminishing to nothing at the edge. It can therefore, more easily than the Cassegrain, be corrected by star tests if workshop tests are unavailable, gradually making the ellipsoid deeper until full correction is attained. This probably explains the predominance of the Gregorian before workshop tests were devised."

Now there ought to be an enhanced interest in the Cassegrain, and a few of the all-but-extinct Gregorian may be attempted too. Mr. Hindle has written for us a compact treatise on these types, and we have made three carbon copies of it to lend out for limited periods to bona fide Cassegrain-Gregorian workers who will swear with one hand on "A. T. M." to return them promptly for the next fellow's use.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Coal and Fuel Oil Held Goods of Same Descriptive Properties

THE case of Transcontinental Oil Company, Ohio Oil Company assignee substituted, *versus* Harlan-Wallis Coal Corporation, was recently heard before First Assistant Commissioner Kinnan. The decision follows in part:

"The applicant seeks registration of a mark comprising the words 'Marathon Coal Best in the Long Run,' the mark being used upon coal, in Class 1, raw or partly prepared materials. The opposer claims through its predecessors in business, prior adoption and use of identically the same mark except for the word 'Coal,' used upon 'carbon or water-white burning oils, refined and semi-refined petroleum, kerosene, gasolene, benzin, naptha, and fuel oils,' and sets up ownership of . . ." various certificates of registration.

"The marks being admittedly identical except for the word 'Coal' appearing in the applicant's mark, and the opposer having fairly established use of its mark upon fuel oil continuously since a date prior to the date of the applicant's entrance into the field, there is presented for consideration only the question whether the goods of the respective parties possess the same descriptive properties or belong to the same class within the meaning of section 5 of the Trademark Act.

"The applicant has earnestly pressed the view that the goods of the respective parties do not belong in the same class and that their inclusion in different classes of the official classification should be accepted as conclusive upon this point. While various adjudicated cases relied upon by the Examiner of Interferences and the opposer show the classification of this Office is not controlling, yet the applicant contends those cases are mainly of the character in which the different goods under consideration were in practice used together.

"Recognizing fully the difference in the physical characteristics of the goods of the respective parties, the different method of handling them and in producing them, yet the fact must be recognized that both constitute forms of fuel for heating purposes, both are frequently handled by the same retailers and sold to the same class of customers. . . ."

The First Assistant Commissioner then cited several decisions; among them "the case of Cross *versus* Williams Oil-O-Matic Heating Corporation is also deemed pertinent to the issue raised in the case at bar.

"In that case the court held the notation 'Coal-O-Matic' when used upon machines for automatically feeding coal to furnaces confusingly similar to the notation 'Oil-O-Matic' used upon devices for automatically feeding fuel oil to furnaces. The court made it plain that it considered the goods belong to the same class.

"It is held that the goods of the applicant and those of the opposer possess the same descriptive properties and belong to the same class as these terms are defined in the adjudicated cases made of record in this proceeding. These cases are deemed fully to establish that the Office classification is not controlling upon the question of what goods possess and what do not possess the same descriptive properties.

"The decision of the Examiner of Trademark Interferences sustaining the opposition and adjudging the applicant not entitled to the registration applied for is affirmed."

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Tire Trademark Registration Refused

IT was recently held by Assistant Commissioner Moore that The Dayton Rubber Manufacturing Company, of Dayton, Ohio, is not entitled to register, under the Act of 1905, as a trademark for rubber tire casings, a mark described as "an inner band of white, a band of red peripherally outside of the white band and a band of black peripherally outside of the red band."

The ground of the decision is that the alleged mark would not impress the public as other than an ornamental design.

In his decision, the Assistant Commissioner said: "It appears to be well settled that marks which consist merely of the inherent characteristics of the goods, rendering them more distinctive or attractive, are not registrable. It is only when a mark functions in the mind of the public to identify the goods as to their origin or ownership that it constitutes a technical trademark and is registrable."

Then, after referring to and quoting from the decision in The Goodyear Tire and Rubber Company *versus* Firestone Tire and Rubber Company, 240 O.G. 641, 1917 C.D. 49, he said: "I am of the opinion that the applicant's mark would not function as a trademark, but would be regarded by the members of the public as being merely for the purpose of ornamentation."

Hotel Radio a Profit Source

HOTELS which make available to their guests in public and private rooms, by means of a central receiving set, broadcasts of copyrighted musical compositions perform such compositions in public and for profit, within the meaning of the Copyright Act, the United States Circuit Court of Appeals for the Eighth Circuit has just determined.

This ruling was made in the cases of Buck, etc., v. Jewell-LaSalle Realty Co., in which the Supreme Court of the United States, by a decision handed down on April 13, held that the transmission of broadcasts of copyrighted musical compositions by hotels to their guests constituted a "performance" of such compositions within the meaning of the Copyright Act.

The Supreme Court, in answering a question which had been certified to it by the Circuit Court of Appeals in these cases, did not pass upon the question of whether such hotels "perform for profit," the cases as presented to the Supreme Court not calling for a determination of this issue.

Guided by the ruling of the Supreme Court, the Eighth Circuit Court of Appeals has now determined, however, that such performances are public performances and for profit. The lower court, therefore, held that the defendant company, owner and operator of the LaSalle Hotel in Kansas City, Mo., could be liable for infringing the copyright of a musical composition broadcast from a radio broadcasting station and transmitted to the hotel's guests by means of a central receiving set and loud speakers.

"It having been thus determined," the opinion of Judge Booth states, referring to the decision of the Supreme Court answering the certified question, "that the specified acts of the hotel proprietor constituted a performance, we are of the opinion that the record discloses that the performance was a public one and was for profit. The words 'public performance for profit' have received a liberal interpretation."

The court refers to an English case, Messager v. British Broadcasting Co., Ltd., 137 L. T. R. 810 (1927) 2 K. B. 543, in support of its holding that the broadcasting of a musical composition constitutes a public performance.

The decree of the trial court dismissing the bill for copyright infringement as to the Jewell-LaSalle Realty Company was reversed by the Circuit Court of Appeals and the case remanded for further proceedings consistent with its opinion and that of the Supreme Court.

"Grand Rapids" Furniture Ruling

THE Federal Trade Commission has ordered Joseph Greenspan, trading as Grand Rapids Upholstering Company, New York, to cease representing his firm as a manufacturer and to abandon the use of the word "Grand Rapids" as a trade name or in advertising, unless and until the furniture described by this name is actually made at Grand Rapids, Michigan.

Use of the terms "factory" or "manufacturers" to describe any building used as the company's place of business, is prohibited, unless and until the concern actually owns and operates a factory wherein furniture sold by the respondent is made.

The phrases "Manufacturers selling direct to the public—Save the retailers' prof-

it," or similar expressions, are also barred, unless and until the company owns or controls a plant in which its product is made.

The Commission found that the company *does not manufacture* furniture at Grand Rapids or anywhere else, except so far as it upholsters a part of its stock, namely, living room chairs, in New York.

The respondent is not an agent or representative of manufacturers situated in Grand Rapids, and little or none of the furniture sold by the company is manufactured in Grand Rapids, according to findings of the Commission.

Golf Green Patent Held Valid and Infringed

AN infringement suit for the alleged infringement of the Fairbairn patent, No. 1559520, has been decided by District Judge Simmons in favor of the plaintiffs, Fairbairn and McCart. The patent covers improvements in methods of constructing golf putting-greens and similar surfaces. The court's decision, in part, follows:

"The invention described in the patent in the suit relates to new and useful improvements in method of constructing the surfaces of playing fields, and particularly adapted for the surfaces of putting greens for golf courses. One of the objects of the invention is to provide a surface for putting greens adapted for use on arid land, which surface will be as near as possible in appearance and effect as the densely-growing, closely-cropped grass which makes the ideal putting green surface.

"Another object of the invention is to use material in which a certain amount of surface friction may be had, rendering the surface action of the golf ball identical with the surface action of a grass green; and still another object of the invention is to use a material which is resistant to moisture. Other objects of the invention are to bring about economy of cost, both in construction and maintenance, and to use a material which will withstand heavy play without disturbing or affecting the putting surface and which may be dyed to simulate a grass putting green.

"These objects are claimed to be accomplished by covering a prepared and properly shaped surface with a suitable flocculent mass, and this flocculent mass is compressed by rolling or other compression. The patentee has found that a most desirable surface can be had by use of ground cottonseed hulls, in which the hull portions still retain a certain amount of cotton fiber adhering thereto. . . .

"The only prior art patents which are entitled to any consideration at all are the Smith patent, No. 815649, which discloses a putting mat made of asbestos felt or sponge rubber; the Stedman patent, No. 957387, for an artificial playing-bed, having a rubber surface; and the Flynn patent, No. 1513978, for a putting green surface made of cattle hair, comprising bristly fibers. No one of these three references can be seriously regarded as an anticipation.

"Nor in the absence of analysis and comparison should much weight be given to them, in the face of the presumptive validity of the patent that arises from its grant, the wide commercial success of the patent in practice, and the undoubted tribute paid it by the present and prior infringers. The patent in suit is held valid in all its claims, and infringed by the present defendants."

Door Closer Trademark Registration Canceled

ASSISTANT COMMISSIONER MOORE recently held that The Everedy Company, of Frederick, Maryland, was not entitled to register, under the Act of 1920, the term "Silent," as a trademark for door closers, and that the registration which it had obtained should be canceled, in view of the long prior use by The Yale and Towne Manufacturing Company, of Stamford, Connecticut, of that term in connection with the door closers put out by it.

In his decision the Assistant Commissioner noted the holding of the examiner of interferences that petitioner had shown no injury since it, in common with all other traders, possessed the right to use and continue to use the notation in question in trade, and said: "The holding of the examiner does not appear to be supported by the weight of the authorities" (citing and quoting from decisions).

Then, after quoting Sec. 4 of the Trademark Act of 1920, he said: "Under this section the petitioner may not associate the word 'Silent' with its door closers without being liable to an action for damages.

"In view of the above, it is evident that the continuation of the said registration would be likely to cause confusion in the mind of the public as to the origin or ownership of the door closers described by the term 'Silent' or by like descriptive terms.

"As the registrant was not, at the time that it filed its application for registration, nor when the petition for cancellation was filed, entitled to the exclusive use of the descriptive term 'Silent' in connection with door closers, I am of the opinion that said registration is without authority of law and should be canceled."

Abdominal Belt Vendors Forego False Advertising

A COMPANY selling an abdominal belt by use of which, it was advertised, "the waistline of a prospective purchaser can be reduced by any definite amount," signed a stipulation with the Federal Trade Commission admitting that some 20 representations made in advertising are "incorrect in certain respects and greatly exaggerated and misleading in others."

The belt vendor company agrees to discontinue such representations as follow: That the wearing of the belt produces a kneading or massaging action and causes fat to be dissolved; that excess fat will continually disappear while the belt is being worn; that the reduction of fat is guaranteed to a wearer of the belt; and that the respondents have had experience in the manufacture or sale of such belts for a greater length of time than they have actually engaged in such manufacture or sale.

Can-Opener Trademark

UNDER the Act of 1905, it has been held that the Vaughan Novelty Mfg. Co., of Chicago, Illinois, was entitled to register a trademark for can openers which included the words "Safety Roll" without disclaiming the words.

In the decision, it was stated:

"There is no showing that these words have been used heretofore in connection with can openers and beyond the mere fact that the device has a feed wheel as part of its mechanism, the words are not descriptive in any sense. The word 'Safety' is not used alone but only in connection with the word 'Roll.' It is believed these terms, so far as the record shows, are fanciful when applied to goods of this character."

Power Companies in Japan

STRICTER control and supervision by the Japanese Government over the nation's electric power industry as well as easier financial accommodation for electric enterprises are provided in a recently revised law, according to a report from Consul Leo D. Sturgeon made public by the Department of Commerce.

According to the revised provisions of the law the competent authorities may, in the public interest, create, change or use in common electric power equipment, divert the supply of electricity, and expand or contract the rate of construction work in accordance with the exigencies of a national network of power lines.

Enterprises cannot dissolve, suspend, discontinue, or transfer the whole or part of their works or amalgamate with other works without the permission of the competent minister. Enterprises shall obtain the permission for newly establishing or changing the terms of supply. The minister also has the right to withdraw the whole or part of authority granted to electric enterprises and may even change the directors of a company in such special cases as indicated in the law.

An electric committee is to be established as a consultative organ to the minister for the proper application of the law.

Trademark Confusion Must Be Avoided

IT was recently held by First Assistant Commissioner Kinnan that Francis L. Dieterich, of Newark, New Jersey, is not entitled to register, under the Act of 1920, the notation "Corkseal," as a trademark for gaskets, in view of the prior registration by another, under the same Act, of the term "Korkpak," as a trademark for the same goods.

In his decision, after pointing out that the marks were clearly so similar that, if otherwise registrable under the Act of 1905, the latter could not be registered, and noting applicant's argument that the Act of 1920, in terms, forbids only the registration of a mark which is identical with a known trademark of another and referring to a decision of the Solicitor of the Department of the Interior, construing the 1920 Act, the First Assistant Commissioner said:

"The whole purpose of all the trademark registration acts would appear to be to grant registration of marks which are not confusingly similar and deny registration to a newcomer where confusion is apparent, since it would appear obvious Congress did not intend by its registration enactments to add to confusion in trade."

Books SELECTED BY THE EDITORS

RADIO FREQUENCY ELECTRICAL MEASUREMENTS

By Hugh A. Brown, M. S., E. E., Asst. Prof. Elect. Engr., U. of Ill.

THIS book will be of value in furthering the knowledge of radio-frequency phenomena of those who are equipped with a knowledge of alternating current electricity equivalent to that usually acquired in the fourth year of college preparation for a degree in electrical engineering. The author states in his preface that "knowledge of the elementary principles of radio communication is also assumed. The book is intended to serve as a ready manual for the use of the radio engineer, and the experienced amateur."

Sources for further reference are given throughout the book wherever necessary for a fuller understanding of any particular branch. An appendix deals with certain recent laboratory arrangements and facilities needed in making specific radio-frequency measurements. One part in particular of this section which held our interest is that devoted to the preparation and use of the Piezo-electric quartz crystal.—$4.20 postpaid.—*A. P. P.*

PROJECTING SOUND PICTURES

By Aaron Nadell, Publix Theaters Corp.

A PRACTICAL textbook for projectionists and managers, intended primarily for theater men concerned with the reproduction of sound. It aims to convey a practical and useful outline of the principles underlying the mechanisms and circuits used for that purpose; and upon this basis to build up a clear understanding of the apparatus, and the methods of operating it most successfully.—$2.65 postpaid.

SCIENCE IN ACTION

By Edward R. Weidlein and William A. Hamor, Mellon Inst. Ind. Research

THIS 287-page volume contains a sketch of the value of scientific research in American industries. The authors have marshalled a vast amount of material, all showing the connection between research and production—laboratory work and dollars. The reader will gain a knowledge of research institutions and what goes on in them which would otherwise require a year of travel and investigation. If you happen to know any multimillionaires who do not yet grasp the connection between research and financial returns, this is the book to slip into their hands. The major stress is on applied rather than pure science.—$3.20 postpaid.—*A. G. I.*

THE SCIENCES DEPENDENT

By J. Arthur M. Richey

IN this book a writer, who is a philosopher but who appears to know his science both broadly and well, criticises science mainly because of its mechanistic and materialistic trends. Though not out of sympathy with science he takes many a sly jab at its aims and methods. What he wants is plenty of God added to our present science and then it will be all right. These critical chapters are bright and sparkling, never for a moment dull. They would be provocative only to a reader who lacked a sense of humor and a sense of detachment. You may not agree with the theme of this book but you will find it good reading.—$2.15 postpaid—*A. G. I.*

THE UNIVERSE

By Frank Allen, Ph. D.

THIS is the transcript of a popular lecture delivered at the University of Manitoba, but somewhat enlarged. In scope it covers much of relativity, space, time, matter, energy, and so on and, though limited in length (142 pages), it would seem a good investment. Length is a poor criterion for a book, anyway; too many long ones might be shorter. This is one book the reviewer expects to save—which means it is regarded as rather more worth while than a lot of books one sees.—$2.15 postpaid.—*A. G. I.*

ELEMENTS OF GENERAL CHEMISTRY

By J. A. Babor, Asst. Prof., W. L. Estabrooke, Asst. Prof., and A. Lehrman, Instructor, N. Y. University

FOR those who have had no previous instruction in chemistry, there is sufficient fundamental information in the text to prepare for further study and the treatment of the subject is broad enough to meet the needs of the large number who do not go on in this science. The periodic table is presented early in the text and the applications and conclusions are drawn around it in a way most comprehensible for the student. All fundamentals are covered in the first part and in the second half the principles are applied—the repetition here fulfills pedagogical purposes to advantage—581 pages plentifully illustrated.—$3.95 postpaid.

A LABORATORY MANUAL for the above by the same authors is of similar size—with text on right-hand pages only, thereby furnishing note space opposite corresponding text.—$2.15 postpaid.

A HISTORY OF AIRCRAFT

By F. Alexander Magown & Eric Hodgins

MANY books on aviation have been issued, but none to our mind as complete and well turned out as is this one. The research and "digging" that evidently has been expended here is tremendous. One reasonably familiar with what has been published must admit that a lot of new material has been uncovered and it all has been woven into as chronological an order as clarity will permit. Twenty-five pages of chronology carry up to July 1, 1931; Post and Gatty. Four hundred and sixty-seven pages and extended index.—$5.20 postpaid.

BERNT BALCHEN

By John Lawrence

FOKKER stated in his book that Balchen is one of the greatest pilots. Certainly one can more readily believe his marvelous accomplishments were based on the most rugged experiences after reading this story of a real Viking. Modest to a painful degree, it is a real bit of diplomacy to be able to extract and find out what details this book contains. You will enjoy every word of it and if you agree with this reviewer, you will be glad Bernt Balchen at last has received his just due.—$1.90 postpaid.

AROUND THE WORLD IN EIGHT DAYS

By Post and Gatty

FEW human accomplishments, outside of Lindbergh's, and that was of such short duration, have so fired the imagination and held the attention of the world as did that of the two unheralded adventurers from the Southwest. Here is their own story. Contrary to general us-

derstanding they were both amply experienced in their lines and this story tells of all that they had experienced before their record flight to qualify them for it. As interesting as it is well told—one you must not miss.—$2.65 postpaid.

ADVERTISING AND ITS MECHANICAL PRODUCTION
By C. R. Greer

WHILE the author designates his work as being particularly applicable to advertising, it is as well a complete and ably presented description of general reproduction—type, composition, electrotypes, printing, et cetera throughout the entire course of producing a brochure. It is most comprehensive, well illustrated, and contains everything concerning advertising and printing necessary to an advertising manager, printer, or student. Four hundred and sixty-one pages well illustrated. A reference we highly recommend.—$5.25 postpaid.

ORGANIZED COMMODITY MARKETS
S. S. Huebner, Editor, Prof. Insurance & Commerce, Univ. of Penna.

ONE of the "Annals" of the American Academy of Political and Social Science consisting of 28 monographs each written by an author specially qualified in his subject. The various exchanges are analyzed as to method of operation and field of coverage; this extending also to foreign markets. There has been nothing issued as comprehensive as this book during the last twenty years—which is evidence enough of the need and importance of this issue.—$2.15 postpaid.

AN EARLY AMERICAN HOME
By C. H. Miller

A DELIGHTFULLY whimsical account of the fun and enjoyment a builder of nineteen houses had in designing and erecting the *one* house he finally selected for his own. Much keen investigation and observation is back of this most readable account and the description and drawings are most explicit; in fact anyone could readily carry similar project with no difficulty at all. You will get a laugh from every page. A marvelous combination of sense and nonsense.—$3.70 postpaid.

THE USE OF HANDBOOK TABLES AND FORMULAS
By J. M. Amiss and Franklin D. Jones

THIS book serves three distinct purposes: first it throws the spotlight on a lot of essential time-saving tables, rules, and general information that the ordinary user never discovers; second it shows by examples, solutions, and test questions, typical applications of handbook matter in both drafting-rooms and machine shops; third it provides test questions that will enable the handbook user, through practice, to obtain the required information quickly.

Even experienced engineers and shop executives will find many helpful hints in this handy book. For younger and less experienced men it provides a condensed course in mechanics, machine shop practice, and engineering, as well as a guide to practical everyday handbook usage.—$1.15 postpaid.

CONCENTRATION IN AMERICAN INDUSTRY
By Harry W. Laidler, Ph. D.

A SEARCHING analysis which describes in a comprehensive manner the extent of concentration of control in the main divisions of American industry. After a brief description of the rise of the great corporations, the author traces the merger and combine movement among our natural resources and then enters the field of public utilities. Part IV deals with the significant developments in our manufacturing and miscellaneous industries. Banking, insurance and investment trusts, agriculture and trade associations are also noted. A thorough study of the whole situation.—$4.00 postpaid.

I FIND MY VOCATION
By Harry Dexter Kitson, Prof. Education, Columbia

BOOKS of this kind are needed particularly now when there is so much fluctuation of employment. It consists of a detailed treatment of the problems one encounters in occupational life, and of the steps one takes in overcoming them. Instead of abstract information on many occupations, it gives the reader a background of principles and practical methods for analyzing and classifying occupations, for determining his own qualifications and aptitudes, and for pursuing a career of his choice.—$1.60 postpaid.

MARIE LOUISE—NAPOLEON'S NEMESIS
By Dr. J. Alexander Mahan

FROM Austrian state papers much new material has been gleaned to show another angle of Marie Louise's influence on Napoleon. The result of this original search has produced a life story as enthralling as any piece of fiction; it combines intrigue, romance and tragedy. It gives glimpses of the glittering courts of Austria and France as the background of this beautiful girl and the domineering man of destiny. Numerous pictures, some hitherto unpublished, embellish an excellent format. 365 pages.—$4.00 postpaid.

TO THE ENDS OF THE WORLD AND BACK
By J. Walker McSpadden

STORIES of 15 field men of the American Museum of Natural History told in their own words, of their experiences and expeditions to the ends of the earth for museum material. A single great elephant group required a special outfit and the expedition was three years in the field. So on down to the individual effort, each tale fascinating with adventure. Fifty-nine illustrations from photographs taken in the field. Young and adult alike will find continued interest throughout.—$3.20 postpaid.

STORIES OF THE STATES
By N. V. Sanchez

A QUICK, accurate, readable account of progressive events from first settlement to admission into the Union, followed by other pertinent data ending with selected reading references. The author is well known for her dependable colonial research and here has rejected much of the stock material so often rehearsed, selecting instead that which gives new life and color to the early days of settlement. Each state seal is reproduced in facsimile, a feature given in few books now in print. A valuable reference for the library of young or old.—$2.65 postpaid.

THE JUNGLE OF THE MIND
By E. J. Swift, Dept. of Psychology, Washington Univer.

WITH wit and learning Dr. Swift examines some of the cults that flourish today—astrology, mental telepathy, new thought, psychoanalysis, numerology and others. He shows how these superstitions trap an innocent and well-intended person, confusing his mind so that he does not appreciate the plain error of his reasoning. He recalls how recent discoveries and inventions have been so marvellous as to make it easy to believe in anything. A most entertaining book and psychologically entirely sound.—$2.65 postpaid.

SCIENTIFIC AMERICAN ADVERTISERS

NOVEMBER · 1931

GEORGE A. TOWNSEND, Mid-Western Advertising Manager
6 North Michigan Ave., Chicago, Ill.
BLANCHARD-NICHOLS-COLEMAN
n Advertising Representative: Los Angeles, San Francisco, Seattle.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

ORSON D. MUNN, President — LOUIS S. TREADWELL, Vice-President
JOHN P. DAVIS, Treasurer — I. SHELDON TILNEY, Secretary

Vol. 145, No. 5. Price 35 cents a copy. $4.00 a year. Foreign $5.00. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year, postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises never authorized. "Scientific American" registered United States Patent Office.

SCIENTIFIC AMERICAN

DECEMBER · 1931 35 CENTS

AND A DIGEST OF APPLIED SCIENCE

Blacksmith Shop in the Ford village of Greenfield, Michigan

WHEN WE WERE YOUNGER

THE blacksmith's calm, ruddy face took on an astounded look when the first gas-buggy came to a jerky stop in front of his shop for service! Staring him in the face, was an idea new to the world!

If you or your father owned a Ford, you learned something in those days that did more to speed up the automotive age than anything else, except the automobile itself. You learned that when Ford sold a car to a customer he followed up the sale by going to the best mechanic in town . . . the blacksmith, bicycle-repairman, or plumber . . . *and giving him a complete lesson in the mechanics of servicing automobiles!* For Ford not only designed, built and sold automobiles, but he also established the principle that a sale does not complete the transaction between maker and buyer, but creates a new obligation on the maker to see that the car gives good service. Ford's cars were bound to give good service, because he saw to it that there was always a local and well-respected mechanic who would guarantee that the car would do its job.

No estimate has ever been made of the part played by these town mechanics and metal-workers in the development of the automobile industry. Yet it was they who adopted the automobile first . . . just as it was from their shops that the first airplane took wings! It was they who made possible today's system of service stations.

Many of them, and the young men they trained, are essential elements of the nation-wide community of Ford . . . repairmen, service men, agents, bankers, even business men of prominence, distinguished members of their communities wherever they may be.

Growing with the industry of which they are an integral part, the entire Ford dealer organization has been specially trained and equipped to service all Ford products . . . automobiles, trucks, tractors and airplanes!

FORD MOTOR COMPANY

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EIGHTY-SEVENTH YEAR • **ORSON D. MUNN, Editor**

CONTENTS · DECEMBER · 1931

BECAUSE OF THIS SPIRIT

The biggest thing about your telephone is the spirit of the hundreds of thousands of people who make up the Bell System. No matter what their particular jobs may be, they are first of all telephone men and women.

The loyalty of these people to the ideals of their work is reflected in every phase of your telephone service. It shows in the increasing speed with which your local and long distance calls are completed. It shows in the greater accuracy with which they are handled. It shows in the wider and more convenient facilities which are placed at your command—extension telephones, intercommunicating systems for home and office, small and large switchboards, teletypewriters and many others.

Because of this spirit, your needs for fast, complete and inexpensive telephone service are more fully met each year. Men and women of the Bell System are constantly explaining the varied telephone services to more and more users. They prepare the way for the new plant and equipment put at your disposal every year. Through their efforts, you receive better and wider service at a cost made possible only by an organization of this character.

Although it does not appear on the balance sheet, the greatest asset of the Bell System lies in the skill, energy and purpose of the people who carry on its work. Every time you telephone, you get the advantage of this—in better and better service at the lowest possible cost.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

SCIENTIFIC AMERICAN, December 1931, Vol. 145, No. 6 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Copyrighted 1931 by Scientific American Publishing Company. Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00.

ACROSS THE EDITOR'S DESK

"HOW would you like to live in a certain section of Kentucky where, owing to a double bend in the Mississippi River, there is an area about ten miles square belonging to Kentucky that cannot be reached from the rest of the state without passing through a part of Missouri or Tennessee?" With this question Guy Elliott Mitchell of the United States Geological Survey starts an absorbing article entitled "Making the Nation's Boundaries," scheduled for publication in our January issue. The importance of marking accurately the boundaries of a state or nation can hardly be over-emphasized, for, as history shows, errors in this work have often led to war. You will be intrigued by the mass of information about the boundaries of our states that Mr. Mitchell has compressed within the confines of an article, and by the human-interest illustrations which accompany it.

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In the early days of the automobile, license laws were lax and regulation of traffic played but a small part in the life of the motorist. As the numbers of cars increased, however, it became necessary to provide for proper licensing of the driver and of the car, and for the handling of traffic. Almost paralleling this has been the course of the airplane. At first there was no regulation, then spasmodic attempts at control, and finally a constantly amended group of laws designed to further operating safety for both the aviator and the public. Colonel Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, has prepared for us an article on the regulation of air traffic. Succinctly he points out that ". . . aeronautical regulation . . . must be in the interests of safety . . . but it must not retard the normal advance of the industry or hamper the growth of aeronautics along any practical line." His article will appear next month.

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Why is it that the Western world is so far ahead of the East in the matter of industrial development, when in the 13th Century China was a highly civilized country as compared with the rest of the world? Dr. Arthur H. Compton, Director of the Ryerson Physical Laboratory of the University of Chicago, has answered this question with four words: "The idea of science." In an article to be published in the near future, Dr. Compton explains further: "The idea of science is simply an attitude that men may have towards the world. It is a desire to find out how . . . outside environment . . . works, coupled with the desire to increase their power to control it." Summed up, his article explains what science really is, and presents that explanation in a clear cut, concise manner.

•

It is axiomatic that Nature preserves a balance in her various duties, but when man steps in and adapts the works of Nature to his own needs, he often upsets that balance—and often to his own detriment. For example, he clears land of all growths so that he may cultivate the soil. Rain falls, runs over his clearings, and washes away the rich top soil, rendering the land barren. Why? Because man has removed the natural barriers to soil erosion, without thought of the consequences. He conducted his logging and cattle grazing operations with the same thoughtlessness. But all this is changing. We are learning the lesson of unrestricted land clearing and the devastating soil erosion that inevitably follows, and are proceeding with more caution. The story of erosion—its causes, results, and remedies—is told in an article soon to be published.

•

Probably the most interesting of all mammals are those which bear a resemblance to man. Thus we are always attracted to stories and articles about gorillas, especially when they deal in particular with the animals in their native habitat. H. C. Craven, of the American Museum of Natural History, spent some time in Africa collecting specimens for exhibits, and has told the story of his adventures in an article which will appear next month.

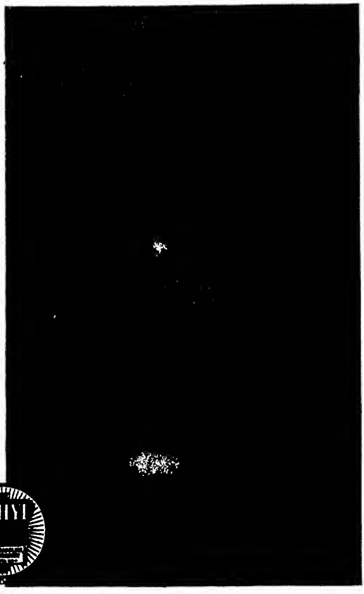
•

A man with poor vision, who, in fact, had to leave school because of eye trouble, was the first man to be able to see things 9000 times smaller than the naked eye can see! The man is Francis F. Lucas, and the instrument that made possible this seeming paradox is the ultra-violet microscope. The invention of this microscope is 26 years old. What Dr. Lucas did was to work out the technique of applying it. The possibilities for research that have thus been opened are almost without limit. The story of the development work and the present applications of the instrument is told in an article scheduled for next month.

Orson D. Munn

1/112 *of a second is a* "RIPE OLD AGE"

for gasoline in your motor



A TINY FLASH—and the spark plug sets gasoline ablaze in your motor; 1/112 of a second—and there is nothing left. The gasoline has burned out and died. Yet in that seemingly brief "lifetime" gasoline has done its job. It has delivered power to your piston—which in turn sends this power to your rear wheels.

When you are pulling up a steep grade or spurting away at the flash of the green light, your engine is under strain. This is the acid test for gasoline. At these times, ordinary gasoline proves to be too "short-lived."

It starts to burn smoothly. But right at the crest of its power it bangs in a fast explosion that slaps against the cylinder walls. *It fails to deliver its full power.* This too-sudden explosion results in harmful knock, power waste, overheating.

That is why nearly all leading oil refiners now add Ethyl fluid to their tested gasoline. Special slow-motion movies show that the magic drops of Ethyl fluid in Ethyl Gasoline *control combustion at all times*—even when the motor is under severe strain. Ethyl Gasoline delivers all its power smoothly, evenly, with a steadily increasing pressure that lets your piston take full benefit of it.

Use Ethyl the year 'round. See how it increases power, gives quick get-away and sends you zooming up steep hills in high. Try it tomorrow. Ethyl Gasoline Corporation, New York City.

The active ingredient used in Ethyl fluid is lead

ETHYL GASOLINE

THOMAS ALVA EDISON

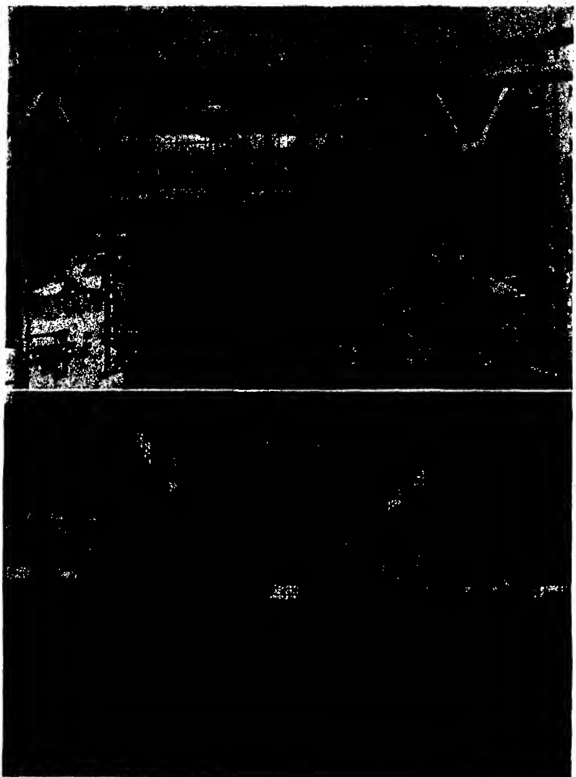
WE have lost a sincere and valued friend, one who for over half a century of eventful activity has ever been willing to respond where he could give aid and encouragement. Mr. Edison died on October 18, 1931.

From the historic day in 1877 when he gave the first public demonstration of his phonograph in the offices of this magazine, to his recent favor of permitting us to reproduce his favorite portrait on our cover, his association with us has been constant and his courtesies innumerable.

Born in Milan, Ohio, February 11, 1847, the son of parents of comfortable means, he early embarked on his own account in a variety of businesses. It was while a telegrapher in Boston that he took out his first patent. No. 90,640, granted June 1, 1869, for an electric vote recorder. From a monetary standpoint this was a failure. His next invention was a stock ticker and this he sold for 40,000 dollars—thus starting a line of inventions represented by over one thousand patents, which placed him among the immortals of industry and science.

The world will mourn the loss of a master intellect; his associates will miss a courteous, kindly gentleman.

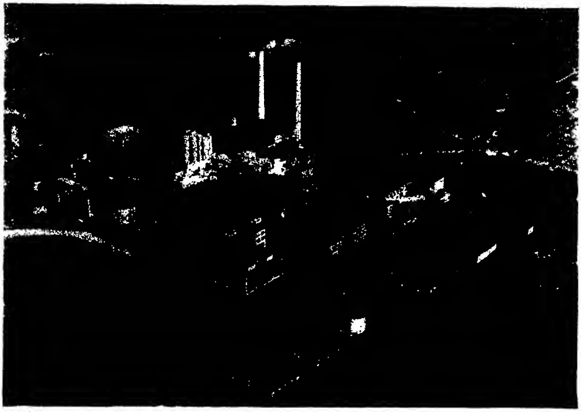
Well may his epitaph be his answer to the question "What is your philosophy of life?" to which he replied "Work—bringing out the secrets of Nature and applying them for the happiness of man. Looking on the bright side of everything."



Photographs courtesy Commercial Solvents Corporation

WHERE BACTERIA HOLD THE CENTER OF THE STAGE

CERTAIN solvents are essential to the conduct of many industries, some of which are mentioned in the article which starts on the opposite page. Four solvents—Butanol, acetone, ethyl alcohol, and methanol—are obtained as the direct result of bacterial action. Starch, obtained from milled corn, is thoroughly cooked and the mash is inoculated with the bacteria. In 48 hours the fermentation is finished and distillation separates the solvents. The upper illustration shows the 800-gallon tanks where the bacteria are cultured, while the lower one shows the 50,000-gallon tanks where fermentation takes place.



This huge plant for the production of commercial solvents from corn has a corn-grinding capacity of 25,000 bushels a day. The storage tanks shown will hold a total of 2,000,000 gallons of solvents

THE CHEMIST LOOKS AT BUSINESS CYCLES

By D. H. KILLEFFER

IDEAS, conceived and discarded during periods of intense business activity, form the centers for that economic growth which cures depressions. The cycles of economic activity and depression have been painstakingly charted and studied but the rôle played in these ups and downs by immaterial by-products of industry has so far escaped proper valuation.

Economists are far too much inclined to look for causes of improvement of business among political and purely economic factors which are, certainly in our modern world, the ultimate manifestations of ideas previously ignored or cast aside as impractical. Yet it seems quite obvious from the viewpoint of science and engineering that these are of prime importance and that we must look to just such apparently remote causes to bring us out of our present business despondency as they have from previous ones. Whether this thesis holds for all past depressions and recoveries is not easy to determine, but certainly it does apply to the depression of 1921 and it seems highly probable that it is in process of applying to that of 1931.

If we consider the lines of activity most emphasized during the World War period and the by-products of these in the form of ideas, the recovery from the 1921 depression becomes quite understandable.

THE prime requirements of the World War each involved the development of materials. Iron, steel, and a variety of metals and alloys, many of them relatively unimportant for peace use before, were essential to ordnance manufacture. Cotton, nitrocellulose, solvents, and other materials used in making them, were needed in great quantity for smokeless powder manufacture on a huge scale. Vastly improved radio equipment was required in coordinating troop activities. Light-weight alloys for airplane and engine construction as well as dopes to render wings and balloons air tight made air operations possible. Automobile trucks, capable of moving vast numbers of men and huge quantities of materials safely and economically over long distances, were needed to make armies mobile.

Thus briefly sketched are the principal new developments forced upon the world by its last great martial orgy. Each of them was imperative and required that great numbers of highly trained men be put to work and driven to the quickest solutions of the many problems involved. No breathing spell could be allowed for stock-taking to decide whether discarded ideas were valuable or not. If they failed to give promise of immediate and valuable application, they must be thrown aside. Yet, in the feverish bustle of doing things, many ideas of great importance, as subsequent events have shown, were conceived. Perhaps it is more important to the outcome that many fertile brains were forced to think intensively along new lines and that the recorded thoughts and discoveries of the past were ransacked for grist for the mills of war.

Considering the five lines of activity noted above along with the developments of the post-war years it is a simple matter to follow their profound effects on business and industry.

Modern weapons and armament required new and stronger steels than existed before. Strength and resistance to corrosion and other destructive agen-

cies were put into steel by the introduction of special alloying metals, and serious investigation of these modifying factors was given extraordinary impetus by the war's demands. An industry in alloys of iron and other metals existed before the war but the forced growth of the war period taught great numbers of men the value of alloys and the technique of their production. The ultimate results of this accumulated knowledge and acquired ability has been the creation, largely on the basis of previously existing industry, of a huge production of many new alloys, both ferrous and non-ferrous, and the finding of important new uses for them.

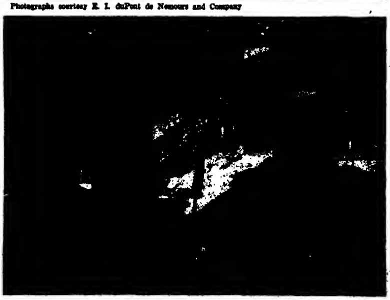
Steels of extraordinary strength, others which remain as bright as silver despite weather, smoke, grime, and the thousand and one agencies which destroy exposed iron and steel completely and quickly, and still others possessing properties quite ideal for special uses of various kinds, all have contributed in great measure to the industrial prosperity of the last decade. In addition to alloys of this type, a host of special metals characterized by special properties—strength combined with lightness, machinable alloys of aluminum, and many others—have come into real industrial importance and aided materially in the recovery from the economic slump following the war activities.

FAR more spectacular has been the growth of new industries on the basis of the "cellulose-consciousness," if one may be permitted to coin such an expression, resulting from the huge accumulation of knowledge of this very common material through smokeless powder manufacture. Smokeless powder is made by the interaction of nitric acid and cotton and the treatment of the resulting fibers with solvents to convert them into solid particles instead of filaments. Of course, there are many refinements in the process of making powder accurately, such as the purification of the raw cotton, the precise control of the nitrating process, the careful sizing of the powder grains, and so on, all of which require intimate knowledge of the properties of cellulose. During the war scores of thousands of men were employed in carrying out these processes to feed the guns at the front and each acquired a certain new knowledge which he sought to make valuable later when jobs were scarce.

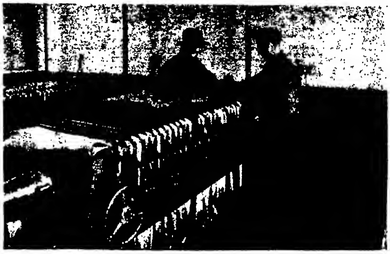
Already before the war there was a small and relatively unimportant industry attempting with indifferent success, as compared with later efforts, to produce silk-like fibers from cotton. Since the processes involved were somewhat similar, the powder makers, after the war, turned to this little industry with their newly acquired knowledge to find a market for themselves. Very few could be absorbed in this way and hence old processes were revived and new ones developed to form the basis for a new industry of sufficient size to care for many more. The perfection of rayon, produced by several different processes, and its development into a major factor in the textile industry which resulted from this sudden acquisition of man- and brain-power is too fresh in the minds of us all to require repetition here.

The intermediate step between smokeless powder and rayon from a production point of view is celluloid and in this field, too, war-trained men found an outlet for their abilities. The remarkable tendency thus introduced into this industry of plastic materials was soon away from cellulose and its products to a variety of other materials,

Photographs courtesy E. I. duPont de Nemours and Company



As told in the accompanying article, lacquer was an outgrowth of war activities. The "dope" used in airplane construction was thought to present many properties that would be desirable in paint, but in its original form, it was unsuited for such application. After much experimenting, a point was reached where a practical lacquer could be produced. The development from that point to the present day has been rapid, and entirely due to the unceasing activities of the chemist. The photographs on this and the opposite page show some of the steps in the commercial production of Duco. At the left is the "devil duster" where the raw cotton is shaken loose from dirt. The lower photo at left (*Continued at right above*)



shows the continuous conveyor dryer used to dry the cotton thoroughly after it has been washed. In the third photograph on the opposite page an attendant is removing from a powerful pres a cotton "cheese," the form which the raw material takes after dehydration. The cotton is then subjected to an involved chemical process, and the base solution of the lacquer is ready to be passed through the layers of filter paper in the press shown at the right above. Before the base liquid can become the versatile lacquer of commerce, it must be colored in a variety of shades. The pigment is carefully weighed (see photo above) and incorporated by grinding with the base liquid in the machine shown at the right

such as casein from skimmed milk, urea synthesized from ammonia, and so on, all capable of conversion to moldable compounds.

A similar off-shoot from the same parent stem of ideas is our now important and rapidly growing industry of nitro-cellulose lacquers. This industry, which sprang more completely than the others from war needs, involves some of the technique of powder manufacture, materially modified and coupled with a much changed celluloid practice. The old lacquers of even the war years produced flimsy, thin, strongly contracting coatings. To replace paint, for ordinary use, they were out of the question. However, with the push of constructive imagination for an outlet that followed the war, the necessary modifications of the old lacquers to make them generally useful as protective coatings were devised and a new industry born.

The development of the radio industry into virtually a public utility, regulated and controlled by governmental agencies, from the crude wireless of the days before 1914 has resulted quite directly from the knowledge of it acquired by many during war days.

War's powerful effect in developing air travel and the airplane's requirements of light-weight power units resulting in great progress in automotive engines are too obvious to require review here.

Probably it is in a sense unfair to omit from the picture the importance of surplus stocks left from war operations. Millions of pounds of smokeless powder, tons upon tons of steel alloys and countless other materials, begging for an outlet, and huge tanks of butanol, acetone, alcohol, and other solvents kept only because they could not be dumped into the streams, as well as vast plants for the fabrication of war needs, interested capital as well as brains and brawn in the forwarding of new ideas.

EACH of these several typical factors powerfully influenced the return of prosperity after the post-war depression, for upon them were built virtually new industries, new consumers of raw materials and labor, and new wealth.

In our present industrial depression one who seeks the sound and substantial solution must retrace the industrial progress of the past decade and dig out the cast-off or half-completed ideas, for among them one is sure to find the keys to future prosperity. Now, if ever, is the time to take stock of what has been discarded in the rush of prosperity, to clean up wastes and to refurbish ideas in preparation for the hurry of activity to come.

One may see suggestions of what the future holds in the revision of food handling methods to apply the new processes of quick freezing; the use of light metal alloys as strong as steel but only a fraction as heavy in building railroad cars and highway trucks; corrosion resistant alloys to replace other materials of building construction; chemical utilization of excess farm products to manufacture useful materials for industry; synthetic plastics as materials of construction on a scale far beyond a cigar holder or a fountain pen; synthetic resins which impart to oil paints and varnishes the valuable qualities of lacquers while retaining the advantages of oil. These and numbers of other developments, crudely embryonic at present, may confidently be expected to become the important factors in the new industrial growth that must soon follow the present depression.

OUR POINT OF VIEW

Extreme Naval Economy

FROM the appearance of things, we have about decided that we do not need a Navy. President Hoover has promulgated the order that, of the 11 destroyers that were authorized in 1916 and were not appropriated for until the last Congress, only five are to be built; and that there is to be no building of naval vessels in 1932. Coming so soon after Secretary of the Navy Adams' expression of the Navy's policy to build up to full treaty strength, the Administration's move comes as a surprise and a distinct shock. Obviously, questions of economy overshadow all other considerations, numerous and potent though they may be, and yet the Navy is told to accept the decision meekly and keep its mouth shut.

As was pointed out in our preceding issue, our Navy building program is already far behind. We were happy to note that 11 destroyers were to be built, for that seemed a reasonable start toward the 150,000 tons of destroyers necessary to give us our treaty quota by 1936. Now, however, we are building only five; and, in other categories that should be engaging our attention, we are to build nothing in 1932 except the relatively small tonnage already laid down. Before 1936 all our present destroyers will have passed the age limit, will be worn out, useless; and other categories will lose—but why continue fatiguing details! There is one thing that we may add and that is that paring down our naval building program has the immediate effect of increasing unemployment tremendously for *70 percent* of the cost of a naval vessel is for labor. Furthermore, it will have a tendency toward faulty construction later on for, as Secretary Adams has said, a continuous building program is absolutely necessary if our naval designers and constructors are to gain the proper experience in the evolution of types.

Public opinion properly marshalled for any purpose exerts a powerful influence. International public opinion marshalled for world peace has borne fruit in the form of the Kellogg Peace Pact and other treaties of a like nature, one of which is the Nine-Power Treaty guaranteeing the integrity of China. And yet at this very moment China and Japan, both signatories to these treaties, are on the verge of war. Perhaps public opinion expressed in diplomatic notes from our State Department and from the League of Nations will have averted actual war by the time this is in print but there is no way of knowing, for this is the first time the world's peace plans have been threatened by a major crisis. Already there is warfare of a sort in Manchuria, and war hysteria is holding sway in both China and Japan. We seem to recall that, after the World War when Japan wished to absorb China, the strength of our fleet was one of the strongest arguments against the move. The present situation, however, in the face of two supposedly strong treaties, becomes a world crisis. Well might those treaties become scraps of paper as others have done in the past.

The United States should not commit the foolish blunder of attempting to dictate to another nation, but it has committed itself to use its influence to help guarantee the peace of the world. This influence is indeed but a puny thing when our strongest argument is simply a diplomatic note. Notes should have something of power behind them, and that something must be a fleet that measures up to the respect we wish accorded us.

Thrift is often a splendid characteristic but economy can become both a weakness and an emasculator. It is a travesty on our national scheme of things that we who—to exhume an ancient formula—spend billions annually on luxuries and billions in filling the Pork Barrel to pander to the smugness of the constituencies of our politicians, can not spend a hundred million or so to build our fleet to the proper balance and maintain our standing among the nations!

Farm By-products

SOME amazing facts were brought to light in a recent address by Dr. W. W. Skinner of the Department of Agriculture. Of the "by-products" of the farm, commonly called "farm wastes," the United States produces annually, he said, cornstalks, 100,000,000 tons; cereal straws, 115,000,000 tons; corn cobs, 20,000,000 tons; cotton stalks, 18,000,000 tons; and so on to a total of 250,000,000 tons.

As Dr. Skinner said, these by-products are composed, approximately, of: cellulose, 40 percent; lignin, 30 percent; and carbohydrates, 30 percent. Of these three, cellulose has the widest use, being the material from which rayon and paper are made. So far, however, little success has been attained in making paper pulp from these farm by-products because of several factors. One of these is the base cost of the material which must take into account the fact that if it is not allowed to rot in the fields, the organic matter it would thus supply can only be replaced by expensive fertilizers; others are the expense of collection, transportation, and storage of the bulky materials.

As far as the chemists are concerned there is no difficulty in this matter. But where they leave off, economists and engineers must step in and make comparative investigations of wood pulp and farm by-product pulp. Furthermore, Dr. Skinner believes that actual mill-scale production for several years will be necessary before the question can be answered. Farmers need not hold too sanguine hopes, therefore, that this additional source of income will be theirs for years to come.

One Dollar For Ducks

CIVILIZATION has many black marks on its record but one of the blackest is its failure to protect and perpetuate our native wild life. Settlements have encroached upon the habitat of animals and wild fowl. Man has cleared land of coverts for agricultural purposes; has drained lakes and thus destroyed resting, breeding, and feeding grounds of waterfowl; and despite the fact that he has made it impossible for game to hold its own naturally, he has failed to make adequate provision either for restoring conditions favorable to the natural multiplication of game or for artificial breeding for re-stocking purposes.

Sportsmen have been the backers of every game conservation or propagation movement of any consequence in this country. It is they who have sponsored or forced legislation to prevent commercial exploitation of game; for it must be confessed that all who shoot game are not sportsmen. There are still many "bootleggers" of ducks who shoot more than the allowable bag and sell the birds. Sportsmen have fought to prevent such illegal shooting—have, in fact, sponsored the legislation that prohibits it, which limits the open seasons for shooting migratory birds, which increased hunting license fees, and which provided for conservation and re-stocking.

In this country today there are several large game associations the aim of which is to see that ways and means are

found for multiplying the numbers of game. To their great credit, it may be pointed out that the programs of these associations, composed chiefly of sportsmen, include education in the observation of game laws, restoration of old natural game bird refuges and the establishment of new ones, breeding of those birds which may be successfully bred in captivity, re-stocking far beyond the bag they are allowed, adequate enforcement of the regulations to stop poachers, duck "bootleggers", and game hogs, and above all, the adoption of an adequate Federal game program.

In the November issue of *Field and Stream*, a lengthy article calls attention to the urgent need of a new Game Refuge Bill with a Federal tax of one dollar over and above the state hunting license fee. This small additional charge which would be paid gladly by all true sportsmen in the event a Federal program of this sort were planned, would make possible the purchase of lakes that have been drained and their restoration as resting, feeding, and breeding grounds for waterfowl. It would pay the wages of a greater number of conscientious Federal game wardens who would bring to court those ruthless killers of game who have little or no respect for game laws. One dollar a year from each duck-shooter would in time provide such a quantity of game that no shooting season would have to be curtailed because of a drought in Canada, as was necessary this year, and great duck clouds like those we used to see will again swarm in our skies.

No Dole For Us

WHEN Congress convenes in December, it will be called upon to consider some form of compulsory unemployment insurance. Its proponents will vehemently deny that their scheme even remotely resembles the dole; but past experience has shown that wherever the state has compelled the accumulation of reserves against unemployment, it has later on had to supplement them with the dole. So far no system of compulsory unemployment insurance has ever been so well-guarded as to continue to function in all contingencies without an allotment of funds from the public treasury.

The disastrous consequences of the British dole have been so widely discussed that there should be no necessity of warning against the adoption in this country of any scheme of insurance or relief that might degenerate into a similar costly muddle. Human nature being what it is, however, it behooves us to repeat that unemployment benefits, of whatever character they may be, stifle initiative and discourage the will-to-work; and the American workingman, possessing a large degree of pride in his own independence and capabilities and in American institutions, does not want them except perhaps as a temporary thing. It has been said that the American plan for unemployment insurance, while being based on the British plan, "does not contain the elements which turned the British plan into a partial dole," but we are not so sure of that. When the British unemployment insurance scheme took effect in 1912, no one foresaw the war and the depressions that so radically changed its nature.

Call it compulsory unemployment insurance or dole—we are not in favor of governmental interference in business. Rather do we look to business and industry to take care of their economic casualties. Jobs must be made for the millions now out of work, for the millions who do not desire governmental charity or handouts. Those jobs can and must be made by business and industry out of the lessons learned from sad experience during the past two years; by those individuals who have hoarded their money and have swelled the balances of the savings banks to an enormous total; and by the government itself. Help for the unemployed must have a practical, dynamic quality; not a passive, sorry-you're-out-of-work nature that will make the justly proud American workingman disgusted with himself for accepting it.

Science's Aim

NOT long ago a layman asked us to explain the practical benefits accruing from Einstein's Theory of Relativity. From the manner of his asking, it seemed as though he expected us to tell him that this theory could be applied to the design of a new carburetor for his car, in the manufacture of a new paint, or for curing some disease. This is not intended to be facetious but merely illustrative of the haziness and even the misconceptions concerning the aim of pure science that have widespread existence in the minds of people in this day of almost universal knowledge.

Recently Professor Einstein explained the aim of physicists in words which fundamentally, in our opinion, are applicable to all pure science. He stated that physicists are spurred on in their work, not by a desire to add to human comfort nor for technological advancement, but merely to arrive at a better understanding of the nature of the Universe. The theories resulting from the physicist's work have their birth in speculation and are the product of observation and experience. They lead, Professor Einstein said, to a simplification of our knowledge.

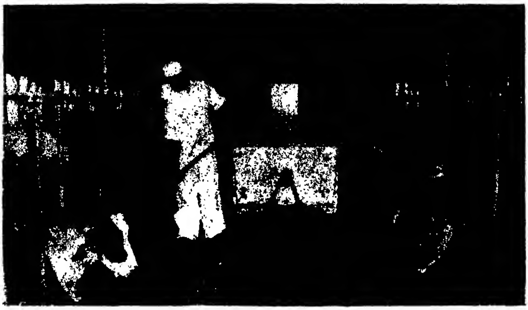
In recent years mankind has drifted farther and farther away from the classical idea of culture for its own sake, but we think there are still but a few people so practical as our questioner who, apparently, must see an everyday application for scientific research or declare it entirely worthless. Abstract science leads on to thoughts of higher things, to the answer of such questions as "What is matter?" and "What is life?"; and has as its ultimate goal, whether declared or not, the uplifting of man to a mental plane beyond anything he can now conceive.

Pilotless Planes of the Future

EIGHTEEN persons stepped aboard a large transport plane of Eastern Air Transport. The Chief Pilot of the company, Harold A. Elliott, took off from the Newark Airport, set his compass course for Washington, threw a clutch, and abandoned his post at the controls. The plane flew on steadily under perfect control for 10 minutes and then Elliott threw in the clutch, turned the plane on a course back toward Newark, again threw out the clutch, and let the plane fly with no hand at the controls. In 11 minutes, so unerring was the aim and so perfect the control that the plane passed over the center of Newark Airport.

This flight was the first public demonstration of the Sperry gyro-pilot which does everything but take off and land a plane. The gyro-pilot is simply the efficient "Iron Mike" of the sea, invented by the late Elmer Sperry, changed and adapted to use in the air. The entire equipment weighs less than 100 pounds and is enclosed in two small aluminum boxes beneath the pilot's seat.

Since the "Dumb Major," as the new device has been nicknamed, handles a plane along a constant compass course under all conditions of wind and weather with undeviating precision, it is said to eliminate the need for pilots trained in blind flying. That is the way of all progress: as soon as we perfect methods of training in blind flying, something is invented to make such training not always necessary. In the future, planes equipped with the "Dumb Major" may fly on regular schedule regardless of weather conditions as long as the visibility at terminals is good enough for taking off and landing. New possibilities, therefore, can be seen for a wider and more confident use of airplanes.



Feeding the cows which give milk that has a vitamin-D content 20 to 30 times that of ordinary milk, due to the irradiated yeast which is mixed with ordinary milk-producing rations

A NEW WAY TO CONTROL RICKETS

By JAMES A. TOBEY, Dr.P.H.

AFTER three hundred years of searching for a simple and convenient remedy for rickets, science has discovered a new and improved method for the prevention and cure of this widespread malady. The prompt adoption of this novel means for coping with the bone disease which now afflicts more than half of all babies in the North Temperate Zone would soon make this scourge as rare as the once dreaded scurvy.

This new anti-rachitic procedure eliminates the use of costly and troublesome medicines, chemicals, and therapeutic devices for the treatment of infantile rickets. It consists merely of pure milk, the normal food of all babies, but a milk in which the content of vitamin D, the rickets-preventing factor, is augmented from 20 to 30 times by natural methods. All milk contains some vitamin D, but the quantity has never been sufficient by itself to prevent rickets.

The increase in the anti-rachitic value of milk is accomplished by scientific feeding of the cattle. A portion of their daily rations consists of feeds which have been skilfully irradiated with ultra-violet light, with the result that vitamin D is transmitted from the feed into the milk secreted by the animals. The process is simple to tell about, but a vast amount of carefully controlled scientific research has been necessary in order to evolve a practical and efficacious method.

The beginning of this work goes back to 1924 when Dr. Alfred F. Hess of New York and Dr. Harry Steenbock of Wisconsin announced independently but almost simultaneously that certain foods could be irradiated under controlled conditions so that their anti-rachitic powers could be increased. Subsequently Dr. Steenbock secured a patent for the process, which he turned over to the Wisconsin Alumni Research Foundation. Under this patent various foodstuffs, such as milk powder, bread, ergosterol, and yeast have been irradiated and placed on the market. The proceeds from the licenses are devoted chiefly to further research for the benefit of humanity.

Dr. B. H. Thomas has conducted research on the anti-rachitic milk

None of these foods is, however, exactly suited for curing or preventing rickets in infants, although they may often be employed with success in the diets of older children. So the quest turned to a method for improving the vitamin-D content of milk itself. After much experimentation, including irradiation of the cows, which proved unsuccessful, Dr. Steenbock and his co-workers announced in 1930 that the vitamin-D activity of milk could be improved by supplementing milk-producing rations with irradiated yeast. Somewhat later Dr. W. E. Krauss reported similar results with irradiated ergosterol.

ACTING on these premises, Dr. B. H. Thomas of the Walker-Gordon Research Laboratories and Dr. Florence L. MacLeod of Columbia University worked out a method for incorporating irradiated yeast or irradiated ergosterol in the rations of Holstein-Friesian cows in a certified milk herd. Irradiated yeast was found to give the better results, as 10,000 units of the yeast were equivalent to 15,000 of ergosterol, and 60,000 units of the former equalled 135,000 of the latter. The yeast is powdered, spread out in a thin film and then irradiated for a brief period with ultra-violet light.

The vitamin D potencies of the butter fat from the cows fed on these irradiated feeds were tested on white rats,

as these experimental animals are the standard for such investigations. Drs. Thomas and MacLeod reported last June (*Science* 73:618, 1930) that the vitamin-D content of this certified milk could be increased at least 16 times over that in butter fat obtained from cows which did not receive irradiated rations.

If this plan works so well on rats, the query arises: Will it be equally successful in human rickets? Dr. Hess provided the answer to this vital question by placing 102 infants on certified milk from cows fed on these irradiated foods. These babies were treated throughout the winter of 1930-1931, a period which provides the most severe test, as rickets is more prevalent in the winter months than in the summer when the ultra-violet rays of direct sunlight operate to activate vitamin D in the human skin of those exposed to such rays.

"THE results exceeded our expectation," Dr. Hess announced at the meeting of the American Medical Asso- in Philadelphia on June 11, 1931. "The best prevention was obtained with the milk from cows which received the greater supplement of irradiated yeast. This milk not only prevented rickets, but was able to effect a cure in a small number of cases in which a test of this kind was undertaken. In addition, the infants thrived well and gained normally in weight. It may be added that the health and nutrition of the cows also was excellent."

Further confirmation of the success of this new milk in combatting rickets has been given by Dr. Edwin T. Wyman of the Infant and Children's Hospital in Boston, where babies have been fed on this product with excellent results. These two clinical tests, carried out independently by competent physicians, have amply proved the efficacy of fortifying fluid milk with vitamin D as a treatment for rickets.

One of the ultra-violet producing machines used in the irradiation of yeast for cow feed

The great advantage of this new method of dealing with rickets lies in the fact that it works automatically. The physician does not have to prescribe anti-rachitic agents the administration of which to the infant requires the intelligent co-operation of the mother. The method is also economical, as the retail price of the milk need not be increased. Most important of all, a scheme is provided by which rickets can be controlled on a large scale as a public health measure instead of through individual efforts only.

A further advantage of this new procedure is the availability of certain essential minerals in the anti-rachitic agent itself. Bone deposition can not occur unless calcium and phosphorus salts are present in the human system and these can be obtained only from the diet. Vitamin D acts as the stimulating agent, but it must have materials to work upon.

MILK is the best known source of calcium, providing this mineral in ample amounts and in a particularly assimilable form. The calcium of milk is, in fact, utilized to better advantage in the human body than is the same mineral as it occurs in vegetables, although certain vegetables, particularly the green, leafy ones, are well supplied with calcium and are helpful in furnishing it in the well-balanced diet.

According to the consensus of scientific opinion, vitamin D operates to increase the solubility of calcium and phosphorus in the blood, thus permitting of an increased content of these minerals in the blood stream and facilitating deposition at the bone sites needing calcification. If the intake of calcium is too great for the amount of vitamin D present, the kidneys excrete an abnormal amount of the mineral. Although massive doses of vitamin D, as in concentrates such as viosterol, may do harm, there is apparently a tremendous range of safety between therapeutic and injurious doses. The a vitamin D in the milk reinforced with this element is far below the factor of safety. If a person drank a quart of this milk, ate half a loaf of vitamin D bread and took several tablespoonsful of cod-liver oil, there would still be absolutely no danger from hypervitaminosis D.

Since June, when Dr. Hess announced his successful clinical test with the anti-rachitic milk, this product has been available to physicians and the general public, although it is produced only at one certified milk farm in New Jersey. As time goes on, however, it will be more widely obtainable, especially since the Walker-Gordon Laboratory, where the new process was perfected, is a unit in a national milk distribution system.

By this method of dealing with the age-old scourge of rickets, whole communities of babies can be protected simultaneously against the disease.

Where many cows are to be fed, mechanization is of great value. At left above, a series of carts are being filled from storage. At right above, the irradiated yeast has been added, and a mash suitable for feeding cows is made with water

SPACE AS YET UNFATHOMED

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THERE has been no more remarkable advance in astronomy, even in our stirring times, than the discovery of the real nature and magnitude of the white nebulae. These objects, distinguished from the gaseous nebulae by their color and spectrum, send us light of just the composition that might be expected from a vast cluster or cloud of stars similar on the average to the sun. But it was less than a decade ago that Hubble, photographing with the 100-inch telescope, found that the outer parts of the two brightest and presumably nearest of these nebulae are actually clouds of exceedingly faint stars.

How some of these stars turned out to be variables of the important Cepheid type, and how this gave a measure of their distance by comparing their apparent and their real brightness, has long ago been told in these pages. Revised data for the real brightness of the variable stars have cut down the original estimates of distances a little, but they are great enough still. For the great spiral in Andromeda, Hubble's latest result is 800,000 light-years. The fainter but more open spiral in Triangulum appears to be a little nearer 750,000 light-years. Three other nebulae in which variable stars have been found lie at distances ranging from 1,300,000 to 2,400,000 light-years. The thousands of fainter nebulae of the same general type must be farther away, but how may their distances be found?

THERE are about 40 other nebulae in which separate stars may be detected on plates made with the 100-inch telescope under the best conditions. These must be relatively near us and it is obvious that we are getting only the very brightest stars among the multitudes which compose them.

Now in the nebulae whose distances had already been determined the brightest stars turn out to be much alike, their (photographic) brightness ranging from about 30,000 to 50,000 times that of the sun; and much the same upper limit of brightness is found in the Magellanic Clouds which are nebulae which lie near enough to us to permit their individual stars to be visible with ordinary telescopes. This makes it pretty safe to assume that among the 40 remoter nebulae the brightest stars in each give 40,000 times the sun's light. The resulting distances range from 1,500,000 to 5,000,000 light-years. Beyond this limit we can no longer hope to see the separate stars—only the hazy light of the whole swarm is strong enough to be recorded.

To go further, Hubble makes the bold step of calculating the brightness of the whole nebula. Comparing the light of the whole mass with that of the separate stars for the 40 cases in which these can be seen, he finds that on the average the nebulae are 15,000 times as bright (photographically) as the stars; so that a typical system gives out 600,000,000 times as much light as the sun. If then we know how bright the nebula looks, we can estimate its distance. The results are rougher than

Courtesy Mount Wilson Observatory

Cepheid variables (between dashes) in a spiral nebula in Triangulum

before, for the nebulae vary considerably in real brightness. Occasionally our estimate might be twice too great or too small, but the evidence is that this would happen in only one case in eight, so that we would usually get a good idea of the real distance.

Now at last we can realize how far it is possible to sound the depths of space. With the greatest existing telescopes it is possible to photograph a nebula of the 21st magnitude—2,000,000 times farther than anything that can be seen with the naked eye. If such a tiny speck of light is really as bright as has just been figured, it must be at the enormous distance of 250,000,000 light-years. An unusually bright nebula indeed might just be caught by our telescope if it were half a billion light-years away.

There must be more nebulae beyond even this limit, so remote that no existing telescope can reveal them. The evidence for this is remarkably simple, depending on mere counts of the numbers of nebulae down to successively decreasing limits of faintness. Suppose we count all the nebulae in the sky down to a given apparent brightness; or if this task is too heavy, in the series of sample regions covering a definite fraction of the whole heavens. Then let us take a lower limit one quarter as bright as before and count again. We will evidently now include objects to twice our former limit of distance, hence we will get all that lie within a sphere of eight times the volume we had at first. Hence if the nebulae are scattered uniformly through space we will get eight times as many as before. If they thin out at great distances the number we find will increase less than eight-fold.

HUBBLE'S counts, when analyzed in this way, show that on the average the eight-fold rate of increase actually occurs right down to the faintest object which can be accurately measured for brightness. The nebulae are still there, scattered no more sparsely than the nearer ones, to the farthest limit of telescopic vision. The material universe extends beyond the utmost limits of our observation. We have sounded its depths with the longest line that human skill has yet devised—perhaps with the longest that human means can supply—and our final report is "No Bottom."

An important corollary from this investigation is that the depths of space are almost perfectly transparent—clear of any sort of obscuring matter. If part of the light of distant nebulae is lost in transit, the limiting distance at which one can see them with a given telescope will be reduced. To get the observed numbers into the smaller volume of space we must assume that the nebulae

are more and more thickly scattered in space the farther one goes from the neighborhood in all directions—an obviously inadmissable conclusion.

Though inter-nebular space is clear, inter-stellar space is sometimes clouded. The great dark patches of obscuration which lie between us and the Milky Way are in many cases conspicuous to the naked eye on a clear dark night. Some of these are associated with stars only a few hundred light-years away. Others are more remote. Now along the central line of the galaxy and for some distance on each side of it, no white nebulae of the extra-galactic type appear, even with long exposure. There must be vast opaque clouds skirting the outer part of the Milky Way which hide everything that lies beyond. The boundary of this obscured region can be traced on the heavens by plotting the regions where one observes distant nebulae or does not. It turns out to be a zone following the course of the galaxy, but of uneven width and with quite irregular boundaries, as might have been anticipated. Here and there a few distant objects are visible through a gap in the clouds, and in other spots

From Barnard's photographic atlas. Courtesy Carnegie Institution of Washington

Obscuring matter in inter-stellar space. Cosmic dust in Ophiuchus

the obscuration appears to be incomplete. But the outer boundary is perfectly definite, and beyond it the skies are really clear. Near the nebulae themselves, however, obscuring clouds reappear. Some of the flat disc-shaped nebulae are turned edgewise toward us, and these are very often crossed by a dark band, obviously caused by opaque clouds lying at the outer edge of the luminous portion.

Though the nebulae are scattered here and there through the whole observable region of space, they are gregarious and cluster in definite regions. In these clusters there are so many more nebulae than in an average bit of sky of the same size that there can be no doubt that we see a real grouping. Making allowance for the minority that lie in front of the cluster or behind it, we find from the rest more about the properties of nebulae than we previously knew.

The range in brightness, for example, is about five magnitudes. That is, the brightest nebulae in a cluster are about ten times as bright, and the faintest one-tenth as bright, as a typical member of the majority. The corresponding range in total brightness is from 60,000,000 to 6,000,000,000 times the sun's light.

The differences in size are more important and depend upon the character of the nebula. The smallest are the nearly circular ones which average about 1000 light-years in diameter. The largest are the spirals with widely extended arms for which the average diameter is 6000 light-years. The intermediate shapes, more and more oval in outline or with less extended arms, are of intermediate size if measured across their widest extent. If the thickness rather than the breadth is taken, all the nebulae are of about the same extent.

THE largest individual nebulae are of about twice the average size for their class and the smallest, so far as can be judged, hardly more than one-tenth the average; so that the brightness of a nebula gives a better idea of its distance than does its apparent size, especially since a nebula has no sharp edge and the longer the exposure the bigger is its image on the negative.

A few nebulae are still larger; for example the great Andromeda nebula which by all tokens is really a giant, is 40,000 light-years across. Our galactic system is still larger and Shapley's epigram still rings true: "If the nebulae are island universes the Milky Way is a continent."

Concerning the masses of these vast systems we know little as yet, but that little is important. Spectra of some of the flattened nebulae show that they are in rotation, one side approaching us and the other receding, compared with the nucleus, at a high velocity. Assuming, as we can hardly avoid doing, that the outer parts are moving in orbits under the gravitation of the central condensation, the attracting mass can be found when the distance of the nebula is known. Results have been published for the Andromeda nebula and one other. In both cases this mass comes out about 3,000,000,000 times the sun's. Enormous as these values are, they are reasonable. The Andromeda nebula and one other gives out a billion times the sun's light and if it was made up of stars like the sun it would have a billion times the sun's mass.

Further evidence in favor of this interpretation is found in the spectrum of the central regions of this nebula. Here no stars are visible even on the

Courtesy Mount Wilson Observatory

A disc-shaped nebula turned edgewise toward us, crossed by a band. The inference has been made that, if our galaxy could be seen from without, a somewhat similar band of cosmic dust would be observed

best photographs, but the light is strong enough to permit the use of a spectroscope of considerable power. The details of the spectrum, according to Adams, indicate definitely that the light comes from dwarf stars averaging somewhat later in spectral type and fainter than the sun.

Such stars give out less light in proportion to the mass than the sun does, and the swarm of a few billions of them would closely resemble the Andromeda nebula both in brightness and mass. If, however, the stars were bright enough to be photographed separately at the distance of the nebula they would have to be giants hundreds of times as bright as the sun but on the average only five to ten times as massive. A cloud of such stars as bright as the Andromeda nebula would not be nearly as massive.

The spectroscopic evidence, therefore, that the central part of the nebula is made up of smallish stars, suffices to explain why it is so massive and why our telescopes do not resolve it. Why there should be numerous very bright stars in the outer regions of the nebula and none in the dense central portion is a problem whose answer must be left for the future.—*Mount Wilson Observatory, October 3, 1931.*

Official photograph, U. S. Navy

A land plane taking off from the flying deck of the U. S. S. *Saratoga* with others prepared to follow

BETTER ENGINES FOR NAVY PLANES

By COMMANDER C. A. POWNALL, U. S. N.

d of Power Plant Design, Bureau of Aeronautics

BY a process of normal engineering improvement, our naval aircraft engines are rapidly approaching the limitations of the basic type. Strangely, since the Navy's air force must of necessity keep pace with those of other nations, the Navy has not enjoyed the privilege of engaging in scientific research in engines—the original development of new and untried engineering ideas. Congressional . . . for . . . purpose are badly needed, not only for the distinct advantage that the Navy may gain thereby, but also that commercial aviation may benefit, as it always has done by naval developments.

At our request, Commander Pownall treated this important subject in the manner we suggested, and the resulting article is presented here with the approval of Rear-Admiral W. A. Moffett, Chief of the Bureau of Aeronautics, Navy Department. —*The Editor.*

AMERICAN aviation engine development is a subject which deservedly is receiving more consideration daily from the American public. This fact was clearly emphasized during the last Congress when a special appropriation of 220,000 dollars was allotted to the Navy to be spent specifically for high-speed development of naval aircraft. The remarks which follow have to do with aviation engine development solely as it applies to naval aeronautics.

To draw accurate comparisons between the military effectiveness of the planes of one nation and those of another is a difficult if not impossible task. Short of war, there is no clearly defined yardstick for measuring military effectiveness of aircraft. The defense plan of any nation is individual and distinct. The fact that one nation chooses to use certain load and power factors in the design of its various types of aircraft, and another nation chooses differently, is no criterion of the lack of design skill of one over the other. The law of gravity shows no favorites as between nations or individuals. It follows then that the fact that America has had no entry in the famous and much publicized Schneider Trophy classic since 1926 does not imply directly that the air forces of the United States are woefully lacking in performance and effectiveness as compared to the air forces of other nations.

THE more experienced and enlightened we become in the knowledge of aeronautics, and the better we understand both the limitations and capabilities of the modern airplane, the more clearly do we realize that each aviation operating project is distinct in itself. Mail planes, passenger-carrying planes, pleasure planes, and Army and Navy types, although in the same general class as airplanes, are in reality vastly different from the standpoint of aerodynamic design characteristics, and as such are not readily capable of interchangeability. The Navy's operating problem is peculiar to the Navy, for the simple but basic reason that the majority of our planes base on board ship and operate over the sea.

This major fact exerts considerable influence upon the design factor of the airplane. The daily operating routine on board the carriers *Saratoga* and *Lexington*, in which squadrons of so-called

land planes take off from the carrier decks, perform their allotted battle tactics against planes and ships distant from shore and the carrier decks, and upon completion, return and alight on board, illustrates more clearly than words the true story of naval aviation development. The fact that such operations are carried out with continuous success almost daily, far distant from shore or any suitable landing place, placing almost sole reliance in the reliability of the airplane power plant, bespeaks of itself a standard of engineering reliability and perfection that one scarcely appreciates, so commonplace has it become. In this respect, the airplane follows the automobile. It is not so many years ago that the automobile was anything but a reliable form of transportation. Its short-comings were numerous. Today we place dependence upon it as an assured means of transportation throughout our daily life, and scarcely bother to ponder the reasons why.

A FEW years ago the airplane engine was basically unreliable as compared to modern standards; consequently the airplane was basically a dangerous machine. Hardly a pilot of those days who has not experienced one or more forced landings due to engine trouble. Today, airplanes nose their way across the sky, over sea and plains, with the methodical constancy of one's own heart beat. Such air achievement, simple as it may seem, deservedly ranks with the great scientific accomplishments of all times. It is a fine testimonial to the brains and courage of the American engineering profession. It is fitting that in an article of this kind we should pay homage to those early fliers and engineers whose faith and perseverance have made aviation what it is today. Many paid the price of pioneering with their lives or fortunes.

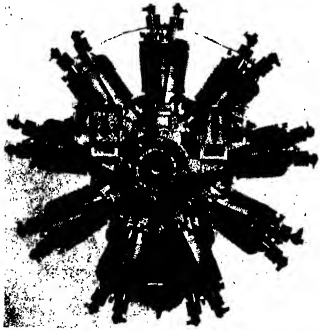
It is an interesting commentary on the design ability of the aviation engineers to note that as the airplane engine has improved in performance throughout the years, it has likewise improved in reliability and durability. For example, a few years ago, a Navy service engine of a given piston displacement was rated to develop 350 horsepower at 1800 revolutions per minute. Today the same basic engine is capable of 500 horsepower at 2200 revolutions per minute and with a greater degree of reliability than existed in the 350 horsepower engine. Another engine which was originally rated at 525 horsepower is today a 650 horsepower engine.

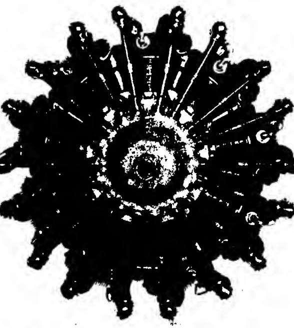
Of far-reaching importance in obtaining added performance with the same or better standard of reliability, has been the improvement made in fuels. It can be said with a fair degree of accuracy that for a given piston displacement, the power output has been increased some 40 percent in 10 years. Of this 40 percent increase, it is estimated that from 10 percent to 15 percent can be credited to better fuels available. Our oil companies are initially air-minded and have contributed a very important part in making the airplane better and more useful to us all. It is my opinion that the succeeding years will be as prolific of development as has been the past.

As stated by an eminent engineer, "The price of progress is trouble," and to "trouble" may be added: dollars. Both the automobile and airplane industries have maintained a rather conservative engine development policy. No radically new theory has been forthcoming. The accepted service engine of both the automobile and the airplane still operates on the old basic conventional Otto four-stroke cycle. Concentration has been placed upon perfecting this type. Compression ratios have been increased gradually, comparable to the improved fuels available. The various systems of the power plant upon which power-producing elements are ever dependent—the fuel, ignition, cooling, lubrication, and transmission systems—have been greatly improved. Today the modern automobile and airplane power plants are gradually reaching the high point of development and perfection, approaching the limitations of the basic type.

WHEN we consider development, there are two courses to pursue. They are parallel and closely allied, but in reality they are distinct in themselves. One we may label as *normal engineering improvement*, the other one *scientific research*.

Normal engineering improvement is carried out continually by both the automobile and airplane industries. This year's car is better mechanically and thermodynamically than last year's; incidentally it is a better value. Likewise this year's Navy fighter is a little better and a little faster than last year's. The boards of directors of the automobile industry decide how much improvement is necessary to stimulate sales. In the aviation industry, the Army and Navy to date constitute the largest individual buyers of aircraft. The airplane industry has not enjoyed the large and steady profits of the sister industry. If the Government would have





Two Wright engines used in Navy planes. The one at the left is the older and the one at the right is the modern engine. The latter represents an improved design with better aerodynamic characteristics and is of much greater power

improved airplanes, it must of itself pay for such improvement. Congress annually appropriates about 2,000,000 dollars to the Navy for this purpose. This amount is broken down and subdivided to take into account every aliquot part of the airplane from propeller to rudder. Approximately one fourth of this amount is usually allocated specifically for power plant improvement. The initial purpose for such expenditure is to make our naval aircraft in their entirety and of all types, more effective as weapons of our national defense. Development under this category is predicated upon the basic design consideration of obtaining added performance with the same or better standard of reliability and durability.

Official Photograph, U. S. Navy

A line of Navy planes, chocks under the wheels, being warmed up

AMERICAN commercial aviation benefits greatly by this development work. Many of the improvements periodically accomplished for the military forces find resultant application in commercial aircraft. The degree of improvement obtained is predicated proportionally to the amount of funds available for such specific purposes. The point of saturation of the design ability of the American aviation engineering profession has not been approached.

Neither the aviation industry nor the Navy has enjoyed the privilege of engaging directly in scientific research as such. By scientific research is meant the development of new and untried engineering ideas. It is recognized that to increase the effectiveness and usefulness of the airplane, it must go faster, and its engine must weigh less per horsepower developed, must be smaller in frontal area, and must burn less fuel. Notwithstanding the enormous prestige now enjoyed by the steam locomotive as a means of transportation, progress has decreed that it must give way to something new and better in the form of the electric locomotive and the internal combustion engine. By the same token it is felt that the time has arrived to supplant old with new ideas in aviation power-plant development.

There is no lack of ingenuity on the part of the engineering profession, nor is there a desire to sit back and avoid the cost and trouble of progress. Various reputable engineers throughout the land and abroad have formulated their ideas, but simply lack the capital with which to design, test, and build. For example, Mr. Ricardo of Great Britain advocates the sleeve valve engine as a practical means for greatly increasing the B. M. E. P. over that obtainable with the conventional poppet type engine. Others advocate the revival of the two-cycle type, whereby it may be possible to increase the power output per cubic inch of piston displacement twofold. Others advocate laying the cylinders parallel to the longitudinal axis of the airplane, thereby greatly decreasing the frontal area; others advocate the specific design of an engine to lay within the wings, not to mention the development of the airplane Diesel engine, and many others.

TO confront these men with the demand that they produce, on the first attempt, something the equal of or better than a perfected type, is an unreasonable requirement. The path of engineering progress is not so simple. The price of development of the German Diesel engine is readily expressed in terms of years of time and in millions of dollars, trial and re-trial.

From the beginning of time, man has delighted in deeds of skill, whether it be physical combat, business sagacity, athletic contests, or pure racing. With the advent of the gasoline engine into our daily life, a new conception of the term "speed" was evolved. Our conventional automobile increased in speed along the highway from 15 miles an hour to 60, 70, and more. Most of us delight in the thrill of going fast. Automobile racing, motor boat racing, and airplane racing became a new and absorbing form of sport and recreation. Unlike other forms of sport where personal skill and physique of the contestant are controlling factors, power racing is a test, not only of the operator, but of the designer as well. It is in reality a race of engineering design wits.

Equitable competition develops perfection. Without competition the designers are inclined to become complacent and contented with their offerings to the engineering art. The designer knows better than anyone else the inherent weakness of the man-made machine. The effect of competition has psychological as well as material aspects. Power speed racing, in which the child of the designer's mind is pitted against that of another, awakens him from his prosaic mathematical point of view and tempts him to trust the gods just a little in the hope of winning. The racing machine, whether it be automobile, motor boat, or airplane, becomes a sort of stimulated robot.

IT is clearly recognized that the Navy cannot of itself act as a promoter of airplane racing chassis. At the same time such races as the Schneider Trophy, Thompson Trophy, and others, achieve their objective—aviation development—by resorting to man's inherent sporting instinct to stimulate mechanical and aeronautical skill in the effort to make the airplane better and more useful to mankind. It is a means best suited to pull out into the open a practical thesis from scientific laboratories. As such, the Government would be short-sighted if it remained aloof.

By reviewing the record of the Schneider Trophy Races, it is interesting to note that in 1913 the race was won at a speed comparable to the ordinary highway cruising speed of today's automobile, that is, 45.75 miles per hour. Few in those days could imagine that in 16 years' time it would be possible to develop an engine and airplane capable of speeds in excess of 300 miles per hour. It is significant to note that the stimulated racing performances of 1923, 1924, and 1925 now find duplication and application in the fully loaded and accepted combat plane of 1931.

It is the earnest hope that Congress will see fit to entrust to the Navy such funds as they deem proper to engage in progressive scientific research with the American aviation industry. Through such action on the part of the Government, American aviation, in its entirety, can and will develop the best that man can devise, and in the end make the airplane increasingly useful not only to our national defense and to commerce, but to mankind in general.

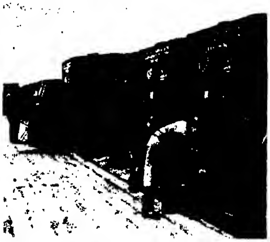
Gondola car with i chandise containers. The sectional sides allow the containers to be removed

SPEEDING UP RAILWAY FREIGHT

AN improved type of container for railroad freight use which does away with the use of cranes for loading and unloading has just been put into service and will go a long way to assist the railroads in handling small shipments economically. This smaller container is largely dependent for its success on a cleverly designed gondola car, the invention of Mr. G. C. Woodruff, Vice-President of the L. C. L. Corporation, which leases equipment to the railroads. In this car the sides drop in sections which permit the containers to be removed sideways by means of lifting tractors. Each section of the side of the car forms a bridge or gangway in connection with the fixed platform of the station. After the containers are removed from the cars they can be loaded by the tractor onto a trailer for transportation to the consignee's premises or hauled directly to an exchange distributing station.

The containers themselves have a capacity of 426 cubic feet. They measure 7 feet 2½ inches in width, 8 feet 2 inches in height, while the length is 9 feet 3½ inches. Eyes and straps are provided so that they can be lifted if necessary. The containers weigh about 3000 pounds each and have a carrying capacity of from 7000 to 10,000 pounds.

The container is used in two ways as follows: First, for transportation from one shipper to one consignee where the shipper has enough tonnage to warrant using containers; second, by consolidators who substitute themselves for the individual shipper or consignee and by gathering up a large number of small packages produce a container load very near the maximum, and act as distributors at the point of destination. For express shipments small containers are ideal as a whole car load of containers can be emptied much quicker than can an express car, and two gondola cars with containers have a carrying capacity equivalent to that of three express cars.

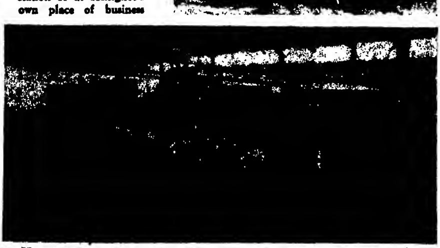


The process of lowering the sectional sides of the car is simple. Each forms a gangway

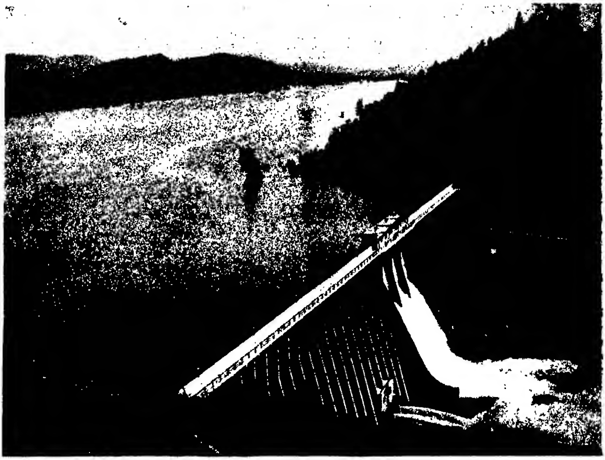
Bulk freight may be broken either at the freight station or at consignee's own place of business

Freight for separate stations can be plac ' ' 'rs which can be drawn off with a minimum loss of time. This time loss is considerable with the usual "way freight" method of handling. The container cannot be opened hil ' ' : car. It is either locked or sealed prior to being put on the car so that theft is well nigh impossible; therefore claims for damages are practically eliminated.

This plan of transporting merchandise seems to afford an excellent means of meeting motor truck competition which is making such inroads in both the freight and the express businesses. In the comparatively few months that the containers and special cars have been in use, their number has increased rapidly. The cars and containers were fabricated at the Berwick, Pennsylvania, plant of the American Car and Foundry Company where the writer of these lines recently saw them under construction.



Here is shown a busy freight exchange station at an important junction. The movable containers present an easy way of classifying freight for all stations



The Stony Gorge Dam which stores up a wealth of water for the Orland Project, California, and thus has all the potentialities for the production of luxuriant crops and the consequent prosperity of farmers

MAN-MADE OASES IN AMERICAN DESERTS

By DR. ELWOOD MEAD
Commissioner, Bureau of Reclamation

THIS year the Subcommittee of the House of Representatives on Appropriations for the Interior Department spent a large part of the summer in the far West, studying the operations of three bureaus of the Department: Reclamation, Parks, and Indian Affairs.

"Why are you doing this?" one of the members was asked. "Is it a junket or is it preparation for an economy program?" "It is neither," was the reply. "It is preparation for an efficiency program. We need first hand knowledge of conditions."

For many years the Interior Department has been the principal settlement and development agency of the country. As custodian of the public domain, with its potential farms and mines, it held the door of opportunity that attracted the adventurous and enterprising. When settlement reached the arid region where irrigation is necessary to grow crops, then the water of streams rather than the land in their valleys became the important resource. Whoever controlled the water controlled the use of the land.

This was a new idea to people whose ancestors came from rainy, foggy England. It took a half century to understand its significance, and public opinion is not yet fully informed of the imperative need of water conservation or the great national benefits received each year from the diversion and use of streams.

AS population has increased, the demand for water has increased and the controversies over the ownership of streams have increased in like measure. The West needs above all things plans and policies for conserving and using its large rivers. That need is becoming acute by the growth of cities. Cherry Creek once furnished all the water Denver needed. Denver authorities filed on Cherry Creek and were content. Farmers filed on the water of South Platte River on which Denver is located. When Cherry Creek was exhausted, Denver had to go to the mountains and tunnel through them to get the water its people must have. The water of City Creek was once sufficient for Salt Lake City. Now, however, a dozen streams contribute to its water supply. San Francisco and Oakland once depended on storages in the surrounding hills. Now they have to go to the high Sierras.

With rare exceptions cities can provide their own water supplies. They have wealth and the necessary organization, but with irrigators it is different. They have neither the money nor the credit required to build the storage and diversion works needed to conserve and use the important rivers of the arid region. Outstanding examples are the Hoover Dam and All-American Canal now being built at a cost of 165,000,000 dollars to regulate and make possible the use of the Colorado River. Hence, so far as reclamation was concerned, the investigation of the Committee was confined to Federal irrigation projects, completed, under construction, and proposed, 20 such projects being visited in

the course of the trip. Some of the economic and engineering results of the Federal reclamation policy, as found by the Committee, are summarized as follows:

The area irrigated in 1930 with water from Government works was 2,790,856 acres, and the area cropped was 2,805,-460 acres, producing crops valued at 119,661,820 dollars. Since water was first available in 1906, the cumulative value of crops grown on land irrigated from Government works is 1,761.929,-500 dollars, which is about seven times the amount the bureau has expended to date. In 1931 there were on the projects 40,354 irrigated farms, with a population of 165,956; 213 cities and towns, with an additional population of 472,723; 688 chools; 724 churches; and 120 bank rith deposits of 134,261,-

170 dollars and 226,014 project and non-project depositors.

What has been achieved by the bureau and the water users on the Federal irrigation projects is an indication of the economic importance of irrigation in the development of the West. A tremendous change has taken place in the West during the past half century in its attitude toward irrigation and its relation to the welfare of this section of the country.

The activities, the hopes, and plans of the arid states of 50 years ago were as unlike those of today as the covered wagon of that period is unlike the automobile of today. A few illustrations will show this. Cheyenne in 1880 was, as now, the capital of Wyoming. It was also a center, probably the chief center, of the range stock industry. The dominating idea was that no life was so alluring as to range cattle and sheep on the free and unrestricted public domain. The grass eaten by the flocks and

On the Minidoka Project, in Idaho. The upper photograph illustrates the character of the land that is reclaimed: a section of the desert covered with sagebrush. In the center is a field of sugar beets irrigated by means of ditches of flowing water. It is to be noted that this crop does not compete with those of the east. *Below:* Thoroughbred sheep in alfalfa

herds cost nothing. There was little provision for winter feed. If anyone realized that the grass could be destroyed by over-stocking and that the industry could survive only by combining it with irrigation, he kept it to himself. The universal desire was to keep conditions and their business unchanged.

Julian Ralph, seeking facts for his book "Our Great West," came to Cheyenne, was told by one of the leading stockmen that irrigation and farming in Wyoming were impossible, that only deluded visionaries advocated it, that Wyoming was suited only to the range cattle business, and that those who talked irrigation would spoil a horn without making a spoon. Today Wyoming has one of the best administered irrigation systems of any arid state. Irrigation saved the livestock industry and no one works harder for more canals and more reservoirs than the cattle and sheep owners of Wyoming who in summer pasture their stock on the public range.

In place of mines, like the Comstock in Nevada, the Little Pittsburgh in Colorado, or the Ontario in Utah, we have great irrigation projects like Imperial Valley in California and Yakima in Washington. We have power projects like the Southern California Edison in California, and the Idaho Power Company in Idaho. One pumps water to irrigate thousands of acres, the other provides electricity to light 10,000 farm homes. We are creating a new industrial empire based on the conservation and use of water.

Statistics are tiresome, but they show as nothing else can how the collapse of the West, threatened by the decline in mining, was averted by the growth of irrigated farming. In 1900 the gold and silver output of Colorado was about 50,000,000 dollars; in 1930, it had shrunk to 6,000,000 dollars. The great Argo and Grant smelters at Denver have been torn down. There are no others to take their place. The processions of ore trains that once came out of the rich canyons of Boulder Creek and the Platte and Arkansas Rivers are gone, and hundreds of miles of railroad tracks have been torn up and carried away. The leading railroad from Denver to Leadville has been abandoned. If in Colorado there had been no other resource to take the place of the declining minerals, if some other profitable employment for labor could not have been found, Denver today would be a decadent mining town with grass growing in some of its streets as it does in Leadville and Cripple Creek.

The resource was there. It was the water of its streams replenished from the snows on its mountain summits and the wonderfully fertile soil of the valleys which border those streams. Together they have created an agricultural industry giving employment to more people and yielding more certain and larger returns than the mines ever did. Denver has become a center of production of crops requiring intense culture and having high acreage value. The Rocky Ford cantaloup and the Greeley potato are known in the markets of every large city. As a result, the dismantled smelters have been succeeded by beet sugar factories. One of the largest creameries in this country is in Denver, and the value of the dairy products of Colorado has grown in 30 years from less than 4,000,000 dollars to nearly 23,000,000 dollars. Meat packing plants and canneries for fruits and vegetables rival those of the large cities of the Middle West. Water has replaced gold and silver as the mineral of first importance in this state.

The glistening silver that is not mined but flows in ditches made possible this up-to-date home of an irrigator-farmer on the Carlsbad Project, New Mexico

THE experience of Colorado has been repeated in every state where the mining of gold and silver was once important. The gold and silver output of Montana in 1900 was over 13,000,000 dollars. By 1930, it had shrunk to less than 4,000,000 dollars. The returns from the gold and silver mines of Washington in 1930 were less than one tenth of what they were in 1900. The Comstock Lode in Nevada turned out in 20 years bullion worth 278,000,000 dollars. Today the costly homes and business houses of the city it created are ruins, the great mine is worked out and nothing like it exists in any state.

Gold is not renewed when the mine is worked out; the miner must look for a job elsewhere, and the store and the boarding house have to migrate with the worker and his wages. This situation has been saved wherever irrigation was

Threshing alfalfa seed, Valley Division, Yuma Project, Arizona-California. The machinery on irrigation projects comes from a

possible, where the miner could shift from digging the precious metals to digging canals to divert water and reclaim deserts. Boise, Idaho; Phoenix, Arizona; Yakima, Washington; and Denver, Colorado, are only a few examples of the prosperous transition from mining to irrigated farming wrought by the conservation and use of streams.

ONCE a river is diverted and the arid, sunburned land below the ditch is subdued, there are employment and income. Irrigation not only brings the surest return of any form of agriculture, but the water on which it depends is renewed each year. It will last as long as snow and rain fall and rivers run. Complete development of the West could, however, come only through reservoirs to store floods, and the costly regulation of large rivers. This task was too great for the individual or group of individuals. It was beyond the resources of the undeveloped states with their shrinking income from mines. Federal reclamation was born to meet a national economic need and a crisis in the business and industrial life of the arid region.

Starting in 1902, the Reclamation Bureau took over works begun by oversanguine and inexperienced pioneers. It became a rescue agency. The Salt River project in Arizona needed a reservoir to store its floods; the Government spent 12,000,000 dollars and built the great Roosevelt storage work and rebuilt the canals and laterals. Marooned settlers on the Yakima Valley in Washington were out of money. Their canal was unfinished. They lacked means of borrowing. The Government took it over, spent 23,000,000 dollars, built four reservoirs, and is building the fifth, which is badly needed, this year. The same kind of development has gone on in every arid state. What has been the result? This extension of irrigation has saved these states from grass-grown streets, declining population, and bankrupt railroads. In the 10 years from 1920 to 1930, the carload shipments of fruits and vegetables from Arizona increased from 1615 to 16,835. The value of fruit produced in 1899 was less than 97,000 dollars. By 1929 it had grown to 3,952,000 dollars.

In Washington, in 1909, the orchards, nearly all irrigated, turned out 2,672,000 bushels of fruit. In 1929 this had grown to 26,656,000 bushels. This explains why the nearby mining towns were not abandoned. The value in money of these orchard products and small fruit in 1899 was less than a million dollars; in 1929 it was 50,625,000 dollars. In Idaho the value of dairy products has grown in 30 years from a little over a million to more than 17,000,000 dollars. A similar record of increase in value of the products of irrigated farms is shown by every arid state. Those products require skill. They give good wages to labor.

Few in the East realize how much irrigation has contributed to the income of their factories and to the payment of interest on the stock and bonds of transcontinental railroads. This support is needed now and will be increasingly needed in the future. The continuation of irrigation development as a national policy insures the progressive growth of every western city, with all that this connotes in the economic life of the Nation as a whole.

A pioneer of the new day irrigates his garden, the water soaking into the parched soil, the desert just beyond. Klamath Project, Oregon-California

An irrigated, healthy orchard produces an abundance of fruit where perhaps only sagebrush grew a few years ago, on the Grand Valley Project, Colorado

POLAND BECOMES A MARITIME NATION

By JACQUES BOYER

General view of the bay and part of the new city of Gdynia

THE famous Polish corridor, formerly having as its only outlet to the Baltic the Free City of Danzig, now has a large bay-window, an all-Polish port, looking directly north upon the freezing water of the Baltic Sea. This corridor had long been a bone of contention between Germany and Poland. Now, with Danzig and the new Polish port, Gdynia, it promises to become a powerful rival of its European maritime competitors.

For over five centuries Poland has been dreaming of and mapping out a route to the sea—a route which would enable her to build up a merchant marine—but her ambitious wish remained only a mental picture until after the World War brought devastation and bloodshed. The Treaty of Versailles gave Poland the opportunity to carry out her plans and she can now send her products out to the cities of the world through her own port. The problem of laying out this port has not been

cess is equally due to the far seeing men of Poland and to the French capitalists and engineers. One without the other would have been futile, and the Danzig bay-window would still be nothing but a blue print.

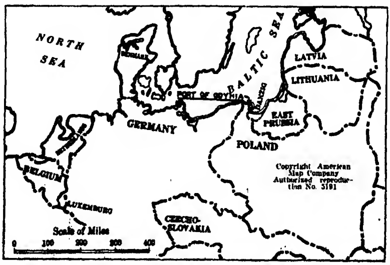
THE ink on the great Versailles document was hardly dry, when, to the discomfiture of the German Imperialists, the Allies sliced off a portion of East Prussia and handed it over to Poland with the recommendation that she use it for peaceful trade. She was also given the right to use the port of the newly created Free City of Danzig. Then a new problem arose upon the discovery during Poland's struggle with Soviet Russia in 1920 that Danzig could not be used by Poland for military purposes. After more delay and more conferences the matter was adjusted by the decision to create a new outlet to the sea.

So in 1921 Poland's problem was to find a suitable spot for a port on the narrow strip of land allotted to her on the shores of the Baltic Sea. Technical studies of several sites were made. The small fishing village of Gdynia, some 12 miles northwest of Danzig, was finally selected as the most appropriate location for

tions of the surrounding territory. All about the fishing village was a vast semi-swamp country with the few patches of higher land rising not more than a few feet above sea level.

This entire territory is cut into two sections by a small stream some 4500 feet long and at some places 30 feet in depth. There is no great danger of the port being filled up by earth brought down by the torrential rains because the hills which form the watershed for the stream are low and the current is not rapid. These same hills, together with the peninsula of Hel, 21.7 by 1.5 miles, form natural wind break against str north and northeast breezes com to this district. Thus the enginee uld plan for a safe harbor for ips. Other water possible future expa n of the port as the establishmen f new industri towns make h a harbor necessary.

It took Poli politicians three years to decide on the location and to s the contract. The engineers had their plans ready and as early as 1921 the Diet voted necessary credit for the construction of a pier over 1312 feet long. But there were technical difficulties and many consultations. Finally, after many discussions with French, Italian, and English firms, on July 4, 1924, Joseph Kiedron, then Minister of Commerce and Industry, signed a contract with the firm of Schneider Hersent and Societe de Constructione des Batignolles in which the latter assumed the responsibility of supervising the whole task. The contract has been modified somewhat during the construction in order to meet new and unforeseen conditions. In its original form, the contract called for the construction of a mole or jetty on the northeast section 2427.8 feet long: a breakwater and a second mole 4039 and 18,553 feet respective-



The Port of Gdynia, on the Baltic, in relation to nearby countries

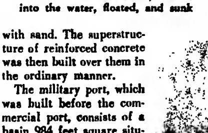
Marshal Pilsudski Basin, one of the several that have been constructed in the port to take care of the vessels of large naval, commercial, and fishing fleets

ly; a pier-head from 26 to 32 feet in depth and 10,166,000 square yards capacity.

The enterprise progressed with remarkable rapidity because of modern engineering and favorable local conditions. Two methods were chiefly employed in the construction of breakwater and jetties. The first used was the well known method of "joined piles" filled with stones to support a solid barrage; the other method called for the construction of reinforced concrete caissons. The foundation of the walls of the piers were constructed of sheeting piles in shallow water and concrete caissons in deep spots.

THE first work was started on the northern mole which follows the line of the Oksyvia Hills. This jetty is of frame construction, it having been found that the wood would resist deterioration due to the scarcity of ship worms and devastating mollusks in the Baltic Sea. The first two 26-foot piers, namely the northern basin and the coal basin, are constructed from ordinary piles with casings of sheet-pile. Over these is built the superstructure of reinforced concrete. These piles are from 9.8 to 11.9 inches in diameter. Some are placed in vertical positions and others at an angle so that the structure may better withstand the pressure of sand and water and the agitation caused by vessels. The concrete superstructure consists of a horizontal slab built on the top of the piles. Vertical concrete walls rise from the sea and are crowned by a granite structure. The slabs are filled with sand up to their crown.

The east mole, the south mole, and the breakwater, also piers 8, 9, 10, and 12 are built upon caissons of reinforced concrete placed one above the other upon bed rock and all are filled with sand. After several trials, a uniform type of caisson was adopted. They measure from 27.8 to 41 feet high and from 19.6 to 59 feet long, and are divided into compartments by transverse bulkheads. These caissons were built on sandy ground only 35 or 40 inches above the sea level, lying on their sides, with bottom ends turned towards the water. The engineers used a very ingenious method to float the complete caissons. The sand was gradually washed away from under them until they stood upright and floated into the sea by themselves. They were then towed to their designated place, filled with water, and sunk. Later the water was pumped out and they were filled



The manner in which caissons were constructed on the shore, washed into the water, floated, and sunk

with sand. The superstructure of reinforced concrete was then built over them in the ordinary manner.

The military port, which was built before the commercial port, consists of a basin 984 feet square situated near the end of the northern jetty. These works were constructed between 1926 and 1928. On the south side of the commercial basin, the contractors have undertaken the construction of a fishing port. For this there is a jetty of 931 feet and a mole of 328 feet, thus creating a basin large enough for a sizeable fleet.

As the traffic of the port of Gdynia increased rapidly, the Polish government in October, 1928, provided for the construction of a greater port. These new facilities are scheduled to be completed in 1934 and include a new basin 10,625 feet across with piers from 20 to 32 feet in depth. The fishing port mentioned above will be further developed by deepening a present canal. This is being constructed jointly with Czecho-Slovakia and will be used by that country as well as by Poland.

It is estimated that at the end of 1933, Poland will be able to handle through this port a vast quantity of merchandise. As a matter of comparison we note that Havre, with all her improvements, has a port of only 11.18 miles and Marseilles has one of 13 miles, while Gdynia has 74.5 miles completed and in 1933 it will exceed 93 miles.

THE increase in Gdynia's shipping tonnage is phenomenal. In 1924, only 24 ships entered her port, with a tonnage of 14,352. In 1927 there were 530 ships with a tonnage of 432,939; in 1929, 1500 ships entered the port with a total tonnage of 1,445,288. This year the tonnage will far surpass 2,000,000.

The important products which pass through the port of Gdynia include rice, chemicals, minerals, tobacco, shell for buttons, herring, and similar commodities. Poland exports through the city a great deal of wood, cement, and eggs. There are vast modern cold storage plants to take care of the perishable food stuffs. For the coal brought from the Silesian mines, there is a separate basin which alone can take care of 1,694,000 tons at one time.

At this writing the little village of Gdynia has developed so rapidly that it has a population of 30,000 and modern homes, schools, and theaters. Poland has the vision, the capable men, and the capital (partly French) to back her future maritime expansion.

After the caissons were sunk in place, the superstructure of reinforced concrete was built up

HAS FOREST CONSERVATION CREATED A FALSE ALARM?*

By **WILSON COMPTON**

Secretary-Manager, National Lumber Manufacturers Association

THE condition of the timber and lumber industries is perilous; in fact, it is ominous.

In timber ownerships and the timber and lumber industries $10,000,000,000 are invested, and they ordinarily furnish employment to hundreds of thousands of men in regions which offer no other industrial employment. The lumber industry has been in depression during much of the past decade, the present crisis being only an accentuation of its particular troubles by the general depression. Lumber stocks are excessive and yet lumber operations are 50 percent less than in 1929, with the result that 150,000 men are out of work. Lumber production and consumption are at the lowest level in half a century. At no time in the last decade has lumber production been as much as 60 percent of the installed capacity.

THIS overcapacity has resulted in heavy and nearly continuous overproduction. The 1929 census determined the production of 1167 sawmills which cut over 5,000,000,000 feet annually, as over 26,000,000,000 feet, or 70 percent of the total cut of 36,000,000,000 feet. These mills—about 6 percent of the total—could readily have produced more lumber than the total consumption of the United States in that year.

Lumber prices of some of the principal species are today about where they were a quarter of a century ago. The erage wholesale price for all species is $16.54 a thousand feet in 1906 and $22 in 1930, with almost continuous further declines since the middle of last year. During the past two years Douglas fir prices have fallen 35 percent, southern pine 33 percent, western pines 30 percent, and southern hardwoods 40 percent.

Notwithstanding low lumber prices, the per capita consumption of lumber in the United States has fallen during the last decade from 500 to about 275 feet. So far this year it is proceeding at the rate of less than 150 feet. This decline is attributed in part to changing styles, customs, and industrial and housing standards and, in a large part at the moment, to the fact that residential building is only a third that of three years ago.

Present and prospective timber supply and present and prospective timber needs have been a prolific source of controversy for nearly half a century. The present generation in America has been periodically warned of imminent "timber famine" and "timber shortage." The purpose of these predictions has been almost uniformly sincere, constructive, and courageous. In some important respects, however, their cumulative effect has become destructive of their very purpose. The succession of published official estimates of national timber stand for the past half century has been in part as follows:

1880	856 billion feet
1896	2,300 billion feet
1900	1,390 billion feet
1905	1,088 billion feet
1911	2,826 billion feet
1917	2,700 billion feet
1920	2,215 billion feet

In 1880 the late Senator Hale, of Maine, predicted that within 40 years thereafter Maine would be barren of timber. At that time the estimate of timber stand in Maine was about 6,000,000,000 feet. Since then Maine has cut nearly 44,000,000,000 feet of lumber and has a timber stand officially estimated at about 35,000,000,000 feet. New England forests generally are now competently reported as growing more timber than is being currently utilized (although of course not as much as is being currently consumed in New England).

Photograph by Jennett Spencer

Ghosts of former grandeur. A once beautiful forest devastated by fire. Snow capped Mt. Rainier in the background

A quarter century ago there were repeated and dramatic forecasts of a timberless America within 30 years. Perhaps the most noteworthy result of that stream of publicity was to inspire a furious and—as it has turned out—an untimely and unwarranted speculation in western timber. Thousands on thousands of persons financially of high and of low degree bought small tracts and large tracts of timber, much of it "sight unseen." Much of it in isolated small holdings in the mountains of the Pacific Coast is worth less today than when it was bought. With the taxes and carrying charges, thousands of these properties represent a net and in some instances a total loss to the investor.

Again in 1919 official and unofficial forecasts predicted that within ten years the southern pine lumber production would have declined from 30 to 50 percent. Ten years later the production of southern pine had declined 10 percent, to about 12,000,000,000 feet annually.

ACCORDING to present admitted estimates of timber stand and of lumber production at the average annual rate of cutting for the five-year period from 1925 to 1929, the timber supply of Washington is sufficient for 35 years, Oregon 91 years, California 141 years, Louisiana 22 years, and Mississippi 26 years. This is without allowance for the extensive new growth of timber, particularly in the western forests. Moreover — being merely arithmetical — it does not make allowance for the extent to which some of this timber is economically inaccessible. These are the five leading states in lumber production,

*Courtesy, *American Forests*, Washington, D.C.

representing one half of the total lumber production of the United States.

Even within the last decade there have been official and semiofficial proclamations of "imminent pinch" of timber scarcity, and of prospective high lumber prices. These and similar statements, sincerely intended as a stimulus to forest conservation, have been exploited, amplified, and exaggerated by other industries seeking to secure the substitution of other materials for wood, and have in fact gone far toward defeating the very purposes they were intended to foster.

I WELL understand that this bare recital of occasional incidents in the last half century's history of timber supply, conservation publicity, and public understanding of forest facts does by no means tell the entire story. Nor in mentioning them am I trying to prove anything except that the succession of forecasts during the past half century have been for the most part inaccurate as to present fact; unsound as to future implications; and correspondingly harmful. I suggest that these facts, and many others which might as well have been cited, may indicate the timeliness, the wisdom, and the probable constructive value of a complete and impartial reexamination of the facts with respect to present and prospective timber supply and present and prospective timber needs.

I do not believe that anything but good will result from a public understanding of the great difference between adequate permanent lumber supply and adequate permanent forests. Lumber supply is only one—probably the most important—of the important purposes of forests. It is readily possible to have an ample national lumber supply without having solved the important forest problems of maximum productive land use and the protective, recreational, spiritual, and other values of forest growth. The two have been unwisely and harmfully confused.

THE perennial flare-ups over forest conservation have brought out some odd human psychology. Apparently there are some who would resist all tree cutting; these regard lumbermen as they would regard wolves. Others seemingly would butcher all the trees and let the devil pay; these regard conservationists as fanatics. Between these two "lunatic fringes" stand the saner majority; these, like the American Forestry Association, would regard the forests just as they regard any crop—to be used and replaced, but to be used nevertheless. Just as with corn, beans, potatoes, and so on, we need—enough. While we do not necessarily subscribe to all the views contained in the accompanying article, we believe that it will provide food for worthwhile thought and discussion.
—The Editor.

Much of the displacement of lumber has been because of the clear superiority of other materials. Such substitution is sound, constructive, and should be permanent. But there is reason to believe that much of it also has been due to unfounded anxieties over the continued availability of suitable lumber supply, unwarranted fears of prohibitive lumber prices, and a vague but potent under-current of public impression, fanned by zealous competitors, that it is rather a patriotic duty to aid forest conservation by refraining from the use of forest products. Abandonment of the use of lumber for these reasons is unsound and should not be encouraged.

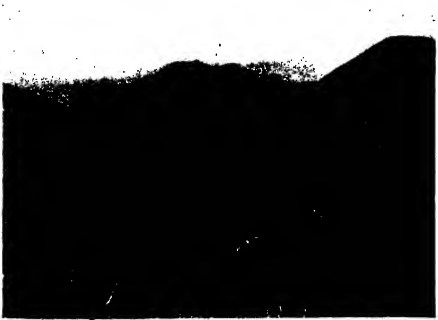
I am prompted, therefore, to believe the public agencies, the forest industries and the foresters alike may willingly unite in a deliberate reappraisal of national timber supply and timber needs in terms of present facts, unbiased and unfettered by previous pronouncements.

Until the last decade the principal financial motive power in the lumber industry has been the appreciation in value of standing timber which often resulted in great fortunes. During the past several years values have become stagnant or have declined. The result is that vast timber holdings have become a financial burden on the lumber industry. The total privately owned saw timber is equivalent to about 50 years' reserve of raw material at the present cutting rate, whereas a 20-year reserve, on the basis of present taxaton, is all that a well-ordered enterprise can stand. This leaves a 30-year supply that the lumber industry cannot afford to carry, making it a business liability instead of an asset.

THE present volume of Russian lumber imports is relatively small; its promised future volume is colossal. Its importance to the American lumber industry is in four facts: first, Russia has the largest timber supply of any country in the world; second, timber is its most accessible and readily convertible natural resource; third, the United States lumber market is the declared chief objective of the Russian export program; and fourth, nationalized timber, confiscated plants, forced labor, and state monopolies in production and distribution afford Russia great competitive advantages which are, properly, denied by law to American lumber manufacturers and distributors.

The remedy for unfair Russian competition may perhaps be found in Section 337 of the present tariff law, which prohibits the importation of goods offered under unfair methods of competition. Under this section the President may suspend the importation of goods against which unfairness is charged, pending final determination of the question by the Tariff Commission. If the law should prove ineffective new legislation should be promptly enacted to remedy any undesirable situation.

The facts that have been presented here point to five outstanding needs in practical timber conservation; viz., dependable control of lumber production, reduction in cost of carrying reserve timber, research, diversification of production and distribution of forest products, and protection against unfair competition, foreign and domestic.



Photograph by F. W. Cleator, courtesy U. S. Forest Service
Another example of the damage that can be done by fire. A watershed on the northeast slope of the San Francisco Peaks, Coconino National Forest, Arizona

The Champion cleaning plant of the Pittsburgh Coal Company serves a number of their mines and gives mechanically cleaned coal prepared to requirements of various industries. This is one of the achievements in the coal industry

MODERN COAL FOR MODERN MARKETS

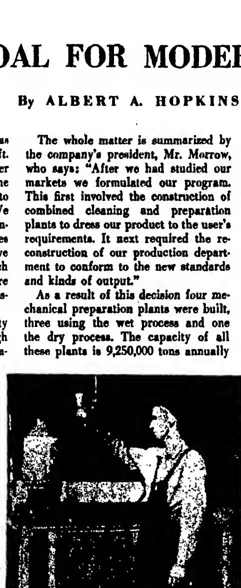
By ALBERT A. HOPKINS

THERE was a time when coal was just coal black coal—hard or soft. We are greatly indebted to Mother Earth for putting the coal into the ground and it is up to us moderns to get it out safely and economically. We have made great progress in coal mining in the last decade. The exigencies of war and the troubles with labor gave the consumer a varying product which in time convinced the buyer that there was coal—and coal; he became the discriminating buyer.

This was the time that opportunity knocked at the door of the Pittsburgh Coal Company. They are large operators having 150,000 acres of bituminous coal lands in western Pennsylvania and 20,000 more acres in Ohio and Kentucky. The coal business was sick, very sick, and an antidote or specific was required. Evidently the old adage about the kinship of cleanliness and godliness occurred to the astute officials. Probably they remembered packaged goods and the Ford assembly line. So the long and the short of it was that the company invested a few million dollars, based on the idea that the coal consuming public would rather buy clean fuel than dirty, poorly treated coal or coal that had never been treated at all. They started out with a proposition that they would "engineer" coal for the market. This required accurate and scientific knowledge of the chief uses and conditions to which the fuel was to be put as well as great financial resources.

The whole matter is summarized by the company's president, Mr. Morrow, who says: "After we had studied our markets we formulated our program. This first involved the construction of combined cleaning and preparation plants to dress our product to the user's requirements. It next required the reconstruction of our production department to conform to the new standards and kinds of output."

As a result of this decision four mechanical preparation plants were built, three using the wet process and one the dry process. The capacity of all these plants is 9,250,000 tons annually of cleaned coal, sized and mixed to individual specifications when required. These cleaning plants do three things: First, they give a clean and carefully graded coal; second, they put out a product which meets the chemical requirements as to ash, sulfur content, et cetera; third, they so standardize deliveries that each shall be the same as regards physical and chemical properties. Thus, coal merchandising has been placed almost in the rank and file of trademarked breakfast foods or low priced automobiles.



Float and sink test shows how well the cleaning operations have progressed

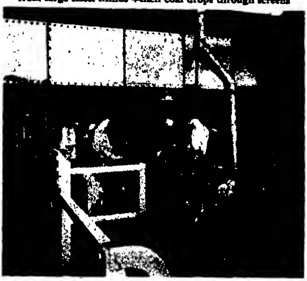
The cleaning plants often serve several mines and the coal is brought to them by railroad cars or aerial trolleys but naturally they are located at or near one mine to save haulage. It was the writer's good fortune to visit the Champion cleaning plant about 13 miles from Pittsburgh, which uses the wet-cleaning process.

The "raw" coal, as it is called, comes in cars which are emptied by a rotary dumper that takes one car at a time and rotates it so that the contents are spilled out over a grating. The coal falls on an apron which is designed to hold the coal back until the car is tilted still farther, so that when the coal finally falls into the hopper under the grating breakage will be minimized. Twenty cars of a capacity of 40 to 90 tons can be dumped per hour.

The raw coal is fed from the hopper to a 60-inch belt conveyor capable of conveying 700 tons of coal an hour to the shakers. At the discharge end of the belt there is a

Left: Dumping raw coal as it comes from mine. An apron delays the fall. *Above:* A 65-inch lifting magnet at discharge end of feed conveyor picks out the "tramp" iron. Much of the salvaged material is usable

Below: Hand picking removes no fuel value material from large sizes. Minus 4-inch coal drops through screens



Part of the coal cleaning equipment which not only rejects the refuse but also assists in the sizing and grading

Left: Sludge filters and fine coal centrifugal driers where moisture is reduced before entering heat driers. *Above:* The heat driers are constantly turned to remove the last of the remaining water

All the coal shipped is under the supervision of chemists who make constant tests

65-inch lifting magnet which takes care of the "tramp" iron, such as coupling pins and links and assorted bolts and nuts. This salvaged material is well worth saving. The belt conveyor finally deposits its load of coal, which is "run of the mine," onto a shaking screen where the "minus 4-inch coal," as it is called, drops through the screen perforations. The plus 4-inch coal is carried on to a second screen where the larger pieces of coal are still further separated as to size. The larger sizes, plus 6-inch and 4 by 6-inch, are shunted on to two parallel shaking tables where hand pickers, all experts, remove rock and other foreign material which is thrown down through pockets. The larger sizes are not washed as this is unnecessary and this coal is run out directly on the loading booms which dump the coal into waiting cars on three of the tracks.

WHAT about the coal waiting for its bath? The tubs and the masseurs are all ready. The minus 4-inch coal, separated from its larger brothers, is stored in bins at the time of separation and is now taken to the top of the plant by a conveyor which dumps it into two primary washers (technically called Rheolaveur launders).

A feature of the launders responsible for the thoroughness of the cleaning is the continuous recirculation of the doubtful pieces of material. With the aid of de-watering and shaker screens the following sizes are separated: furnace, stove, stoker, pulverized, and slack. Clear water sprays play on the classifying screens to remove fine particles adhering to coarse pieces.

If necessary, other treatment is given by means of seeming intricate but really simple machinery. Bucket elevators raise the coal when necessary. Provision is made to avoid any added moisture in the coarse sizes of coal by means of de-watering screens, air jets, small unit heaters, and steam coils located at strategic points on the conveyors.

The fine coal has more attention given to its toilet. After it is cleaned, the fine coal with its clinging water passes into two concrete tanks to allow it to settle, the super-natant water being removed by de-watering elevators. A scraper conveyor line discharges the coal into centrifugal driers which reduce the moisture considerably prior to its admission to the rotary kiln driers. The fine coal is then run through great driers heated with hot gases and constantly rotated. A conveyor takes the coal to the mixing and loading plant where the cars are filled and sent out into the world to help keep us warm or to help our industries. All the refuse—slate, rock, dirt, and so on is a total loss to the company but a saving to the coal consuming public.

The loading booms have a gate which can be manipulated to divert the flow of coal from the cars just loaded to the incoming empty car. Any size or combination of sizes can be delivered to the car, thus meeting any specifications of the consignee. This feature alone cost as much as the average or ordinary coal tipple. The shipping clerk has an elevated office over the loading tracks.

The sampling of the product is done automatically. On each of the clean coal conveyors is an automatic sampling gate through which the samples drop into a bin from which they are conveyed to a gyratory crusher which crushes the coal down to ¼-inch pieces. Then about 10 percent is cut out automatically and this is quartered down still farther until the required quantity is obtained. All the samples which are rejected are returned mechanically to the raw coal fed to the plant.

The dust nuisance seems inherent in the coal industry but here it is hardly noticeable. Everything is concrete and steel and the old idea that a dusty plant is inevitable has been exploded. In the Champion plant over 50 percent of the wall area is window space. The artificial illumination is excellent and the ventilation is good. The psychological effect on the workmen of a light, clean plant with fine showers, lunch room, and above all safe conditions, can hardly be over-estimated.

THE dry-cleaning is accomplished on a different plan. Gravity flow is utilized as far as possible so that only four men and a foreman are required to operate the plant. The entire screening operation is performed on the top floor, and the air cleaning on the floor below. Cyclone dust separators remove all but the finest dust from the air as it leaves the tables. Nine hundred horsepower is required to treat 320 tons of coal per hour.

"Enjoyment of poor health has been so fashionable in the bituminous coal industry" says *Coal Age* "that it is not always easy to distinguish between chronic invalidism and hypochondria." The companies that are making outstanding progress in building for permanent gains are doing so by intelligent and sound management, plus coal sales engineering and the modernization of both mines and treating plants. The Pittsburgh Coal Company has done what the industry as a whole must do eventually and their great success was gained only by painstaking scientific research and is a tribute to the potency of the research laboratory.

Loading coal on six tracks. The lump coal is all loaded on left hand tracks. All the screened sizes are loaded by adjustable booms to avoid br

TRADEMARKS IN DISGUISE

By SYLVESTER J. LIDDY

Member of the New York Bar

THIS article is not intended as publicity, or perhaps more aptly, as ballyhoo, for a new and amusing magazine which appears to have taken the country by storm. That delightful publication wends its merry way without visible assistance—except from advertisers who appear to be quite content to have their well-known brands fantastically disguised and burlesqued. "Disguised," yes, but not beyond recognition and therein lies one not-so-amazing secret of its success.

Advertisers and advertising agencies have long been aware that the public is "brand conscious." But we were not always aware that we could recognize trademarks in their new and often hilarious disguises. Thus we chuckle when we are advised to use "Blisterine" to cure "Athlete's Foot." The addition of the letter "B" to "Listerine" has not fooled us—except willingly.

When we are told that a well-known missing Justice of the Supreme Court used "Bond's Vanishing Cream" to efface himself completely, we grin and think it would be great if someone would use Pond's Vanishing Cream on the current depression. And so it goes.

THERE are those, however, who disguise and simulate trademarks for an entirely different purpose. Attorneys who specialize in handling trademark cases and suits for unfair competition based essentially on trademark infringement find that it is a common experience to have a stranger drop in on them at the office, unfold a drawing or sketch of a proposed trademark, and after glancing about furtively and sometimes involuntarily, whisper, "Can I use this mark?" or "Can I register this in the Patent Office?" "This," usually turns out to be a poorly disguised imitation of some well-known trademark. The answer to both questions is of course "No," and the visitor is told that even if he should secure registration of his deceptively similar mark he will continue to use it only at his peril. Rarely, if ever, do these trademark pirates present for consideration a "Chinese copy" of the pirated mark. That would be too flagrant. They change a letter here or there, if it is a word mark, or substitute a similar symbol, device, or arrangement of elements, if the mark to be stolen is a design or pictorial representation.

The underlying theory on which these infringers work is that the average purchaser will not stop to examine closely the trademark on the goods he is purchasing, but will give it a casual glance and just as casually jump to the conclusion that he is buying the genuine brand. It is rare that an opportunity is afforded for a side by side comparison of the genuine and the spurious.

But all infringers are not crude in their methods. The man who exactly copies another's mark is soon detected and finds himself paying damages. So too with the less subtle infringer who makes merely immaterial changes in the trademark to be simulated. But the clever crook is careful as to which mark and, more important, which *type* of mark he selects for pirating. And right here lies the danger in adopting as brands, trademarks which are technically weak, if in fact they are trademarks at all.

THE purpose and function of a trademark is to indicate ownership and origin of the goods bearing that mark. If a trademark does just that and does it well the owner should be satisfied. But frequently the merchant, manufacturer, or distributor places too much of a burden on his trademark. He expects the mark itself to do all his advertising for him and at the same time describe the virtues of the product on which it is placed. He forgets that a purely descriptive word is a poor trademark at best and frequently no trademark at all. He attempts to appropriate exclusively to himself a word which has long found lodging, as an adjective of merit, in Mr. Webster's excellent Hostelry for Words. He wants his trademark to "carry a message" and that is just the trouble. The descriptive word *has* carried a message from the day it was conceived. Perhaps many messages. But he wants it to carry his message *only* and therein lies the rub. In order that a descriptive word serve only his purpose it must cease to serve all other purposes and must cease to function as it has always functioned. Consequently, he is attempting the impossible when he tries to take exclusively to himself a word which has long since been dedicated to the public. It cannot be done. The trademark pirate knows this and profits by it.

"Ivory" for soap is a good trademark, but "ivory" for elephant's tusks is not and the reason is obvious. Any one may use and properly use "ivory" to describe elephant's tusks.

"Delicious" for prunes is either descriptive or deceptive depending on whether one likes prunes. At all events the word "delicious" as applied to a food product is not a good trademark.

Owners of trademarks, however, frequently spend considerable sums in attempting to popularize, as a trademark, a descriptive word. After the advertising campaign is well under way, but before the owner (?) of the descriptive mark (?) has a chance to build up a possible secondary meaning in the descriptive word, the pirate steps in and, with an air of innocence, begins using the same word in a purely descriptive sense on a directly competing product. If such use is challenged his defense, of course, is that he has a right to use such a descriptive word in a descriptive sense in common with everyone else. In the absence of other acts of unfair competition the defense is a good one, the damage is done, and the proprietor of the descriptive mark belatedly decides to change his brand, adopt an arbitrary mark, and keep away from descriptive terms in the future.

THE wise merchant adopts as his mark a word such as "Kodak." When the Eastman company adopted this coined word it meant nothing, but by effective advertising and the excellence of the product itself, "Kodak" has become probably the best known trademark for cameras in the world. The trademark pirate fights shy of a mark of this kind. With wholly arbitrary marks, such as "Kodak," there is absolutely no excuse for another to adopt as a trademark for a competing product, a word which even faintly resembles it. A trademark thief would have a hard time explaining for example why he used "Kodac" or "Rodak" for cameras. No longer could he argue that he is using a purely descriptive word in a descriptive sense.

Experience has taught the business man that a few hours devoted to the careful consideration of his trademark may later save him years of litigation in a possibly vain attempt to protect a technically weak mark, thoughtlessly adopted, from infringement by an unfair competitor.

HOW STABLE IS THE EARTH'S CRUST?

By HARLAN T. STETSON

Director of the Perkins Observatory at Ohio Wesleyan University

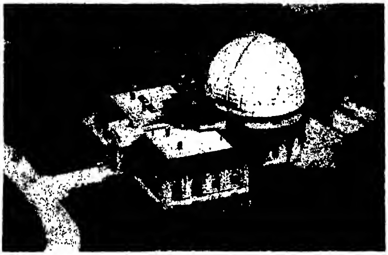


Figure 1: An aerial view of the Perkins Observatory at the Ohio Wesleyan University, where investigations of earth-tides are being made

EVERYONE is quite familiar with the fact that tides in the ocean are caused by the gravitational attraction of the moon. Perhaps, however, few realize that, while the water of the earth's surface yields readily to the moon's tide-raising force, the supposedly solid crust of the earth itself also yields slightly for the same cause. Years ago it was pointed out by Lord Kelvin from the study of ocean tides that the earth itself could not be a perfectly rigid body, but must yield ll amount in order to account for a somewhat lesser height of the ocean tide than would any theory allow which was based on the supposition of an absolutely rigid earth.

What appears to be a new method for studying tides in the earth's crust under the pull of the moon's gravitational force results from an extensive study of astrommical observations of latitude now being conducted at the Perkins Observatory (Figure 1).

Various experiments have been made at various times and places for detecting a theoretical tide in the earth's crust. Perhaps the most successful of these was one carried out by Michelson and Gale, of the University of Chicago, in the grounds of the Yerkes Observatory at Williams Bay, Wisconsin, some 15 years ago. These scientists buried a horizontal pipe, half filled with water, 500 feet long, many feet below the earth's surface. By ingenious optical devices they were able to photograph the advance of the tidal wave as the moon went about the earth. The difference in the height of the tide observed in the pipe and that computed on theoretical grounds, assuming the earth perfectly rigid, showed just how much the earth's crust yielded to the moon's gravitational pull. They determined that the earth yielded with approximately the same elasticity as steel. What this experiment really gave was the amount of tilt of the buried pipe with respect to the water level, and could not give any indication as to a change in absolute direction of the plumb-line with respect to the stars.

Investigations now in progress at the Perkins Observatory, Delaware, Ohio, consist in the analysis of many thousands of observations of latitude at a given place on the earth's surface extending over considerable periods of time. Results already published show that the latitude of a given place on the earth's surface varies, not only with the month in which the observation is made, but depends in a very real way upon the position of the moon in the sky at the time that these observations for latitude were made.

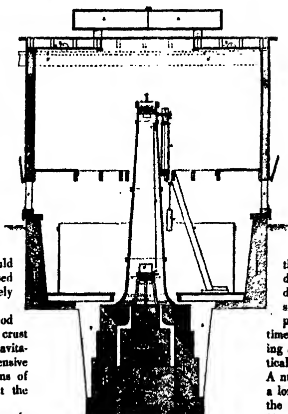


Figure 2: A diagram of the east-west section of the Gaithersburg zenith tube, an astronomical instrument with which the latitude of a point from the equator is determined with great accuracy. The analysis of many observations made with this instrument first led to the discovery that the moon distorts the vertical as it passes overhead. See Figure 4, opposite

THE most precise method for determining latitude known to science is to photograph stars at the zenith of the observer. If the plumb-line, which represents the direction of gravity, is extended indefinitely upward it will pierce the sky in the true zenith. Fixing this point among the stars from time to time is, then, a very nice way for studying any change of direction of the vertical at any point on the earth's surface. A number of years ago Dr. Ross made a long series of such observations with the photographic zenith tube (Figure 2) at Gaithersburg, Maryland. It was from a careful analysis of such observations that the author, with the assistance of a student at Radcliffe College, first obtained definite evidence that the position of the zenith changes with the altitude of the moon above the horizon. A shift in the position of the zenith means that theoretically the latitude of the observer changes, for as the observer wanders north and south over

the surface of the earth he carries his zenith with him.

It was not a new idea in astronomy that the latitude of a given place on the earth's surface varies from time to time. This was definitely shown by Chandler in this country from observations made many years ago at Cambridge, Massachusetts. The variation in latitude, however, which Chandler discovered, was due to a migration of the earth's axis within the sphere of the earth itself, consuming a period of something like 428 days. In every-day language, this is equivalent to saying that the earth's north pole wanders about over the arctic ice fields, the maximum migration being something less than 60 feet.

Figure 3: Variations in latitude plotted against the moon's hour-angle, 1913-1914. Each point is based on 300± observations

As this meandering of the north pole causes a considerably greater change in the position of the zenith than any tide in the earth's crust could possibly produce, corrections had to be made to all the published observations before they could be used in the present investigation. Several thousands of these observations were entered into a card catalogue and duly corrected for this known meandering of the north pole before the present search for a tidal variation was undertaken. After the cards had all been carefully prepared and the numerical work checked, the position of the moon in the sky at the time the observations were made was then entered upon the cards. The cards were then sorted with respect to the number of hours that the moon was east or west of the observer's meridian. The result is shown in Figure 3.

THE most casual glance at this curve shows that the latitude of Gaithersburg was appreciably greater when the moon was near the meridian than when the moon was rising or setting. As the magnitude of the variation is small, only the seconds of arc and decimals of seconds are written on the vertical scale of the curve. The horizontal scale represents the hour angle of the moon, or the time elapsed since the moon was on the meridian, when the values of the latitude as represented by the several points were obtained.

If we suppose that this change in the value of the latitude is due to a slight bulging of the earth's crust as the moon passes overhead, we see from Figure 4 that the change in the perpendicular to the earth's surface is toward the north. This means that the measured latitudes in the northern hemisphere will be somewhat greater as the moon nears the meridian. This is in agreement with the results of the latitude curve in Figure 3. On the basis of the earth being as rigid as steel, however, we should not expect a change in the vertical of more than one one-hundredth of a second of arc. It will be seen that the observed change was actually much greater than this.

The displacement of the vertical at a given moment would seem to depend quite directly upon the actual distance of the observer from a point directly under the moon, which we call the sub-lunar point. It was therefore decided to calculate for each of the cards in the catalogue the actual altitude of the moon in degrees above the surface of the horizon at the time a given group of observations was made. Whereupon the cards in the catalogue were rearranged according to the increasing value of the lunar altitude.

The result of this new approach to the problem is shown in Figure 5, and gives a more startling curve than that in Figure 3. Here it will be seen that the extreme range in value of the latitude at Gaithersburg is nearly 0".1 of arc, the maximum value of the latitude occurring on the average when the moon is some 30° above the horizon. The fact that the range of variation is nearly 30 times as large as the probable error of the point representing the observation leaves little doubt as to the reality of the phenomenon. Furthermore, as this range is nearly ten times as great as would be expected from any tidal effect in the earth, on the assumption that the earth is as rigid as steel, the interpretation is all the more puzzling. Are we to assume that the earth's pole is shifted in some way so as to account for the peculiar behavior, or can it be that the crust of the earth has shifted in an unknown way to account for this peculiar behavior? Is it possible that the [illegible] a so[illegible] of loose-skinned affair which yields far more than would have been expected, and that our older theories based on the idea that the earth is rigid throughout must be abandoned or modified?

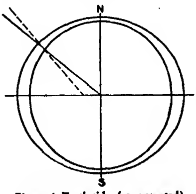


Figure 4: Earth tides (exaggerated) showing change in perpendicular

Geologists of late have been coming to the conclusion that, while the core of the earth is rigid, there is a semimobile layer between the core and the earth's crust, lying about 70 miles below the earth's surface. If such is the case, then indeed it may not be unthinkable that the skin of the earth yields in this somewhat uncanny way.

IT will be seen then that the investigation of this problem of the variation of latitude is quite as much a concern for the geologist and the geophysicist as it is for the astronomer. The astronomer himself must be very much concerned, for the observed positions of the stars and all astronomical bodies depend even as much upon the position of the observer at the moment of observation as upon the motions of the celestial bodies themselves.

It was not unnatural that we should wish further confirmation to such startling results, and accordingly a similar card catalogue was prepared which should include all the observations made with the photographic zenith tube after its removal to the Naval Observatory in Washington. The government astronomers kindly provided us with all available data, and a further investigation of the variation in latitude with the position of the moon was made on the basis of these new data. The results when plotted in curves give the graphs depicted in Figures 6 and 7. The graph in Figure 6 shows the change in latitude at Washington throughout a whole lunar day, the hour-angle of the moon being represented as before in the horizontal coordinate. The portion of the curve existing between 18 hours (moon rise) and 6 hours (moon set) bears a close resemblance to the general form of the curve shown in Figure 3.

Then the results were again translated in terms of the altitude of the moon, this being in effect a measure-

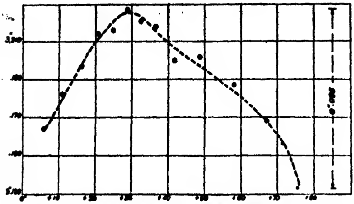


Figure 5: Latitude-variation and moon's altitude, 1911-1914. Circles are based on 600± observations, dots on 300± and 74±

ment of the distance of Washington from the sublunar point at the time the several observations were made. This gave another striking graph—Figure 7. The portion of the curve represented between 0 degrees and 70 degrees corresponds to the observations made when the moon was above the horizon, and shows a fair resemblance to Figure 5 based on similar conditions in the Gaithersburg work. The portion of the curve between 70 degrees and 0 degrees shows what happened when the moon was passing under the earth. Perhaps the lack of symmetry between the two branches of the curve shows the difference in geological structure of the earth in the two hemispheres. The fact that the curve in Figure 6 shows a different form when the moon is east of Washington than when it is west of Washington, may represent a different structure of the earth's crust in the denser portion under the Atlantic than in the less dense portion under the continent of North America.

SOME years ago Wegener proposed the theory that the continents were more or less detached affairs which floated about on a semi-fluid layer beneath. The theory seemed so fanciful and, so far, lacking in observational evidence for its support that scientists were rather reluctant to give serious consideration to Wegener's ideas.

Just recently, U. P. Lely, a scientist, reasoning on theoretical grounds, has come to the conclusion that there are distinct tendencies for a hypothetical floating continent to move either toward or from the pole under gravitational forces. The direction of motion, whether north or south, would depend upon the position of the center of gravity of the continental mass. If we were to allow a displacement of Gaithersburg or Washington along the earth's surface laterally, we might well account for the extraordinarily large variation of latitude with the rising and setting of the moon. After all, the entire movement would be probably less than ten feet, which is quite a microscopic amount when we consider the size of the earth as a planet.

Furthermore, a lateral displacement of the observer would cause an immediate displacement in his zenith, which would not necessarily be evident through any appreciable tilt. This would appear to make the rather large value for the change in latitude found from our study entirely consistent with the results obtained from the Michelson and Gale tide experiment already described. It is obvious that the level of the water in the 500-foot pipe would change with the slightest tilting of the earth's crust with respect to the water level. We should, however, get no effect if the whole pipe were shifted bodily at right angles to gravity. A crustal shift, however, would be immediately discerned in the shift of position among the stars since this would be equivalent to the motion of a moving ship sailing north or south.

Of course it is entirely possible that, with extended studies of latitude changes at widely distributed stations, we may find a certain amount of continental twisting with the rise and fall of the crustal tide. The prevailing direction of certain mountain ranges and other topographical features of the globe suggest that something of this kind may have happened in geological history.

Geology tells us that, whatever may be the primal origin of the earth, through unthinkable but rather definitely measurable epochs, our planet has undergone drastic changes. Earth movements throughout thousands of millions of years have created continents; raised mountain ranges; depressed shore lines; evaporated seas; united and severed, and again united, the Americas. Huge ice sheets crowded southward from Canada, scouring valleys and carving canyons. The ice shrunk, leaving vast moraines, lakes, and roaring torrents. Sedimentation built up plains and silted ocean beds. Suppose that a cinematographic record of the last half billion years were compressed into the 15-minute showing of a single reel. How the earth would appear to heave and writhe, its surface wrinkle and straighten, its rock grow and vanish with unceasing change.

SUCH interesting questions have already stimulated further investigation and the investigators at the Perkins Observatory are now carefully analyzing another set of observations obtained near the west coast at Ukiah, California, another one of the stations adopted by the International Latitude Survey. Preliminary results already obtained appear to indicate that the station at Ukiah goes through a cycle of latitude changes with the rising and setting of the moon, but with a marked difference in phase from that of the eastern stations. It is believed that if one of these photographic zenith tubes were to be set up in a mid-continental section, further observations would render a curve quite different from those obtained at either Washington or at Gaithersburg. One hopeful sign for the furtherance of observations on this problem comes with the news that the old station at Gaithersburg, formerly operated by the Coast and Geodetic Survey, will soon be reopened and a new set of photographic data acquired.

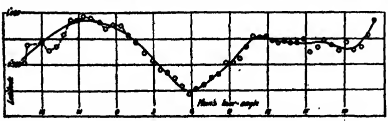


Figure 6

The curve at the left shows latitude variation plotted against moon's hour-angle. The one below, latitude variation and moon's altitude. Both were based on data obtained in Washington, 1924-1927

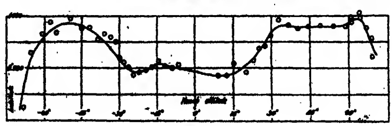


Figure 7

FROM THE ARCHEOLOGIST'S NOTE BOOK

Masterpiece of Minoan Art

THE Toronto Museum has a unique specimen of Minoan art secured through the enterprise of the Director, Mr. C. T. Currelly, to whom we are indebted for our photograph. It is a gold and ivory image which is a masterpiece of Minoan (Cretan) craftsmanship of, roughly, the first quarter of the 16th Century B.C. It was in private possession in Crete for many years. Sir Arthur Keith, the great authority on Minoan art, says: "We have here in fact 'Our Lady of the Sports' though still the Mother Goddess in one of her numerous impersonations." It clearly bears a relation to the old Cretan sports of the bull-ring. It is 10⅛ inches tall. We also illustrate a statuette of a Minoan Snake Goddess in the Boston Museum of Fine Arts. It is 6½ inches in height, is carved in ivory, and richly decorated with gold. The whole prehistoric age of Crete has been called "Minoan" from the legendary king Minos. The Minoans have left us little or no sculpture on a large scale so we must rejoice that such beautiful small specimens have come down to us.

Above: **"Our Lady of the Sports," a figurine of the Minoan Mother Goddess from Crete. *Extreme left:* Figure of Minoan Snake Goddess**

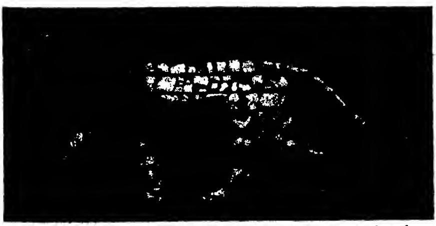
Babylonian Brick Reliefs

TWO important examples of wall decoration of enameled brick from the famous Procession Street of Babylon have been acquired by the Metropolitan Museum of Art. The lions are in relief with colored manes on a turquoise blue background. There were about 60 lions on each side of the street. It is believed that each brick was modeled and a separate mold made for it. The bricks were baked, the outlines of the design were painted in black and filled in with colored enamels, and the bricks were fired again. They sometimes show enamels in three colors which, owing to the great skill of the Babylonian craftsmen, do not flow into each other. The potters of Mesopotamia evidently understood the artistic uses of both lead and tin glazes.

It was an extremely difficult job to piece together the fragments of this little ivory and gold figurine. The body was made in two pieces and the arms were attached. The restored statuette is shown above, left

A Link Between Hellenistic And Roman Painting

WHEN the Metropolitan Museum received this polychrome vase from Centuripe it was badly broken but has been cleverly joined together. Evidently the Sicilians of ancient Centuripe expressed their somewhat flamboyant taste in the forms of their pottery but adhered to the earlier Greek tradition in the character of the decoration. The cover is removable and is painted in tempera, a delicate medium which does not make for good preservation and makes us thankful for the Athenian black glaze. It probably dates from the 2nd or 1st Century B.C.



Panel of enameled brick from the Procession Street at Babylon, dating from the 6th Century B.C. The bricks were refired after painting with colored enamels

Polychrome vase from Centuripe dating from 2nd or 1st Century B.C.

BUTTERFLY FAKING—

Specimens of rare butterflies bring high prices from collectors and this fact has led to the latest "racket" described on these pages. Illustrated above, pinned to a block of cork, is one of the genuine butterflies which the artists use as models

COLLECTORS of rare objects in many diversified fields appear to be considered "fair game" for hoaxers the world over. When a person becomes inoculated with the desire to collect a certain class of objects, he usually goes about it with an enthusiasm that all too often is not tempered with the good judgment that will enable him to avoid the pitfalls placed in his path by the unscrupulous. Such enthusiasm has been responsible for the many spurious specimens of Roman bronzes, ancient statuettes, antique furniture, and paintings of the old masters that have flooded the markets of the world for many years. As long as there are uninformed buyers who are willing to pay the price, such products will be produced.

One of the latest industries to grow up in answer

The first step in the preparation of a butterfly reproduction is to remove the dust-like scales from a common moth or butterfly, so that the artist can replace them with colored metallic powder which simulates the scales of the rare butterfly that is to be reproduced

Below: Putting the artificial scales on a wing which has been reconstructed from the wings taken from common butterflies

Right: The reconstructed wings care-fully attached to the body of a mon specimen, which body closely resembles that of the butterfly being reproduced

A NEW INDUSTRY

to the demand for rare objects has recently been uncovered in Paris and reported to us by our Paris correspondent. This industry has to do with faking butterflies —changing common moths and butterflies so that they can be sold, even to the more cautious collectors, as genuine rare specimens.

The initial investment in this rare butterfly reproduction business consisted of the purchase of several genuine specimens that cost a total of several thousand dollars. These are carefully guarded when in use by the artists, and are kept in a safe at all other times.

The concern conducting this business employs collectors to furnish them with quantities of common specimens. The wings of these are removed, and the bodies classified as to their resemblance to those of rare specimens. Sometimes the wings are used whole, but more often large wings are built up carefully from smaller ones, making sure that the tiny veins match exactly. A transparent waterproof glue is used for this work. From this point on, the operations are illustrated.

After the wings have been attached to the body, and all changes made, the reproduction is placed for some time in a box with damp sand, so that the delicate wing structures will be rendered pliable

After the reconstructed butterflies are removed from the box shown at right above, they are mounted on this special board. The wings are then carefully spread apart and held in position by pinned tapes

Below: An expert putting the finishing touches on a specimen that has been prepared, made pliable, and mounted. A finely pointed pencil brush is used here

Left: A top view of the mounting board on which the reconstructions are allowed to dry before being offered for sale. Accurate reproductions bring high prices

STONE AGE MAN'S WORLD-WIDE CULTURE

By J. REID MOIR
Fellow of the Royal Anthropological Institute
Author of "The Antiquity of Man in East Anglia," "Pre-palaeolithic Man"

THERE are few departments of science which have advanced more rapidly in recent years than that of prehistoric archeology, and it would seem as if at last the early history and development of the human race is to be regarded from a rational standpoint. It is, however, not so long ago that it was generally and tenaciously held that paleolithic man inhabited only western Europe and southern England, and that during his sojourn on this earth, upon which he was but a late comer, he had

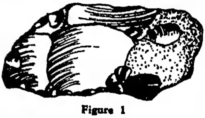


Figure 1

lived in a state of degraded and unchanging savagery. There is, in fact, no other subject in which the innate conservatism of the human mind is more plainly exhibited than in that of prehistoric archeology, and it has been only by the courageous interpretation and making public of the results of recent researches that the old and stultifying opposition has been at last overwhelmed. In the new era which has now opened, our whole outlook upon the past history of the human race is being transformed and some of the conclusions to which recent discoveries are pointing are remarkable, to say the least.

IT is my purpose in this article to deal with one of these conclusions which, it appears to me, is of the highest importance to all those numerous people who take an interest in their remote ancestors. The great activity in archeological research which is now manifest over practically the whole of the earth is showing, among other things, that the people of the Stone Age had an enormous area of distribution. In Egypt, Palestine, India, and in south, east, and central Africa, it may be stated with confidence that paleolithic man existed. This fact in itself is of much significance and constitutes a great step forward from the days when it was believed that he had lived only in western Europe and in southern England.

The material which has been recovered in these widespread researches is now becoming available for study, and I have had the opportunity of closely examining some portion of it. The modern archeologist is not content with merely the recognition that any given

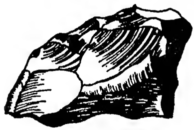


Figure 2

Rostro-carinate implements from (1) eastern England, (2) India, (3) Rhodesia, and (4) Palestine, illustrating the similarity of implements flaked by widely separated pre-historic groups
Drawings by the author

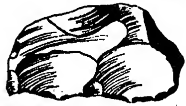


Figure 3

piece of flint has been flaked by man, and is either of paleolithic or of neolithic form. The exact manner in which these implements were made is now a subject of study, and it is becoming possible to say that at different periods of the stone age very distinct techniques in flint flaking were in vogue. This has, of course, long been recognized in France where the differing manner in which artifacts of upper paleolithic industries were made is now generally accepted. In England, where the lower paleolithic industries are so splendidly represented, a like recognition in regard to them has come about, and as I have pointed out in one of my articles in the SCIENTIFIC AMERICAN,[1] it is now possible to realize exactly how lower paleolithic man set out to make his implements. Moreover, this study has made it clear that he proceeded upon a definite and carefully thought out plan, the execution of which was possible only to an expert flaker of flint.

[1] July, 1928.

It is necessary that these facts should be recognized by all those who wish to be in a position to appreciate the real significance of recent archeological discoveries. The development of the primitive point of eolithic times into the earliest forms of the rostro-carinate, or beak-shaped, implements (Figures 1, 2, 3, 4) was no mean feat for the dawning human intelligence of the remote days when this progressive transformation was carried out. This development was undoubtedly the result of experi-

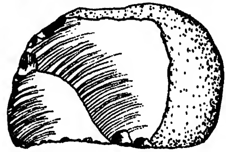


Figure 4

ence and careful thought, but it does not imply the same order of intelligence which was able to produce the hand axe with its two opposed cutting edges (Figures 5, 6, 7, 8) from the rostrocarinate with only one. Here, it seems obvious, a better type of brain was in charge of matters, and to study the large number of rostroid hand axes now available for examination is to realize that these specimens testify beyond cavil that man was indeed using that wonderful organ, his brain, to some purpose.

As one examines these rostroid hand axes it is possible to see clearly the object which their makers had in view and how they set about attaining it. The implements show by their forms that the old age-long habit of making rostro-carinates was, as it were, struggling for supremacy with the new desire to produce an artifact possessing a massive butt for comfortable prehension, opposed to a tongue-like projection with two cutting edges capable of more numerous and skilful uses than the single sharp keel of the rostrocarinate. These transitional implements usually exhibit a beak-like profile, while the remains of one or other, and sometimes of both the dorsal and ventral planes of the rostro-carinate are retained. It is because the specimens

show so clearly these characteristics that I have called them rostroid hand

But it is not only in these transitional forms that the relationship of the rostro-carinates to the earliest hand axes is observable. When an examination is made of the kind of flaking which both types of implements exhibit, it becomes obvious that they were made by means of a very similar technique. This particular method is known as "free flaking," in which the side of the flint from which the flakes are removed is not supported by the hand or by some other object. It results in the detachment of flakes which tend to be thick and to possess prominent bulbs of percussion, and which are of greater width than length. Thus it is possible to claim that the rostro-carinates and the earliest hand axes show by manifold that they are closely related to each other.

It was from a study of the large series of specimens found chiefly in eastern England that the above conclusions were made possible, but when I first published my conclusions they were met by considerable opposition on the part of archeologists. Since those days, however, further evidence has been forthcoming in England, and now corroboration has come to light in places as far apart as Palestine, Africa, and India. Not only

Figure 6

is this gratifying but it is also astounding, and brings up for solution certain problems regarding ancient man which in interest and importance are unsurpassed.

In the first place it may be said that, to those who have made a really close study of flint flaking and the manufacture of implements, it is not possible to believe that it was, for example, merely a "coincidence" that a race of people living in India proceeded to make their stone implements on a precisely similar and highly specialized plan as did another race living in eastern England. No school of a common necessity would produce results of this kind. Such a school would probably bring about the production of simple implements with rough cutting edges, but to imagine that it would give rise to artifacts of a precisely similar and complex manu- ture is to ask too much of prob- ability. If we found, for example, that certain type of specialized carved rniture was present over wide areas of the earth's surface, we would not think of attributing this widespread similarity merely to coincidence; and in the same way it is necessary to shut out this explanation in regard to the flint implements under discussion.

I have recently had the opportunity of examining a large series of rostro-carinates and rostroid hand axes found in Palestine by the British School of Archaeology in Egypt, by Wayland in Uganda, by Neville Jones at Hope Foundation, Rhodesia, and by Cammiade in eastern India, and it is literal- spec- *ized and complex plan* as was being followed in eastern England in early Pleistocene times. I illustrate here rostro-carinates and rostroid hand axes in order that readers may be able to

Figure 5

Rostroid hand axes from (5) southern England, (6) India, (7) Rhodesia, and (8) Palestine. Such artifacts indicate that Pleistocene man used his brain to advantage

Figure 8

recognize the similarity to each other of the specimens from four very widely separated regions. There would not seem much doubt, though this is not yet finally established, that the implements from India, Rhodesia, and Palestine are, like their counterparts from England, of early Pleistocene date.

It would indeed be strange if a race of people living, say, in South Africa at some recent period, went through the same process of evolution of their stone implements as was carried through in England only in the early Pleistocene Epoch, and all the evidence now coming to hand is definitely against such a supposition. To what conclusions, then, are we to come about these remarkable facts?

THERE appears to me to be only one, and it is this: that the knowledge of how to make rostro-carinates into hand axes spread from a common center and was carried over a great part of the earth's surface.

If, as seems to me inevitable, we must adopt this explanation (not only for the culture of early Chellean times but for most other prehistoric industries as well), then other considerations of outstanding importance immediately

re could not have been ı ıtive, nor the means, in thos rapid spread of a pre- c culture, and a very great period must have been taken up in the dis- ial technique in implement making from England to India, for example.

It may here be pointed out that the geological evidence relating to the antiquity of man in no way clashes with these conclusions, for it is becoming fully realized that the human have appeared upon this

Figure 7

earth many hundreds of thousands of years ago. The recognition of the spread of prehistoric cultures from common, though at present unknown, centers makes it also necessary to believe that ancient humanity was much more organized and advanced than has been supposed. But if there is one thing above all others that recent research in prehistoric archeology is teaching, it is that stone age man was not the hopeless and degraded savage which some have depicted.

It is now seen that stone implements alone can give us but a very imperfect picture of the cultural attainments of our remote ancestors and, as new discoveries are made, so our attitude to these matters is undergoing profound change. Prehistoric man is, in fact, slowly but surely entering into his rightful kingdom.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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New Waterproof Lime

WHAT is claimed to be the greatest advance in the lime industry in a century is the recent development of a waterproof quicklime suitable for masonry work. This new product is a pulverized quicklime so treated that the heat generated during the slaking creates a chemical reaction of such a nature that the resultant mortar made with the lime putty, with the addition of the necessary sand and cement, makes a water repellent mortar.

This should be of great interest to architects and contractors who in recent years have been worried considerably by leaky walls. It would appear that there is some connection between the prevalence of efflorescence and leaky masonry and the decrease in the use of lime in recent years.

This seems to be borne out by the tests carried on by the Bureau of Standards on the subject of "Volume Changes in Masonry Materials," which tests apparently show that a mortar composed of two parts of lime putty, one of portland cement, and nine of sand, shows the least volume change after hardening. This subject is treated in paper No. 321 by the Bureau of Standards.

The waterproof quicklime now on the market is not recommended at the present time for use in concrete work as complete tests have not been made covering its usage in this way.

First Translations of Maya Glyphs

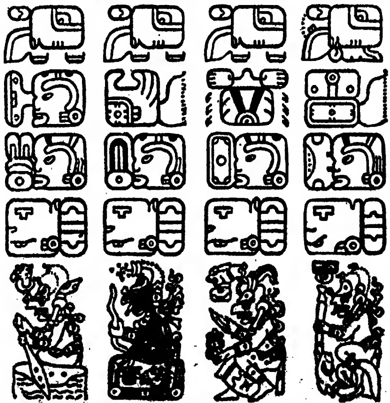
THE first translations ever made from Maya hieroglyphic writing are tentatively offered by Dr. William Gates, research associate in Mayan history and language at the Johns Hopkins University.

Dr. Gates has succeeded in definitely translating various isolated glyphs, the first actually deciphered since scientists took up this study.

Dr. Gates has treated Maya hieroglyphs as experts do code. He has tabulated all distinct glyphs found in the three ancient Maya books that survived the Spanish conquest, grouping each symbol in all the combinations and modifications in which it appears in these ancient texts. Some 2500 distinct glyphs were found in these books, and about 100 minor glyphs. The Mayan language has a system, Dr. Gates says, and it was possible to determine that certain elements were affixes to major glyphs, modifying, classifying, and describing them. It is in these affixes, Dr. Gates says, that the true key to Maya writing lies.

These tabulated symbols he has gathered in an "Outline Dictionary of Maya Glyphs," just published by the Maya Society through the Johns Hopkins Press. This glyph dictionary is in reality a skeleton form on which other glyphs as identified have a place. Thus placed in order, many characteristics of the language have become apparent. Calendric and astronomical glyphs, and others relating to crop and hunting activities and the like, came out. Pairs of opposites and likes, such as earth and sky, food and drink, could be distinguished.

The American Indian languages are like no others, Dr. Gates says, and the hieroglyphs, too, are different from those found anywhere else. The languages spoken by seven main groups of Mayas in Middle America today are related to an ancient common mother tongue as modern Italian and French are related to ancient Latin. The "Mayance" languages, as he calls them, were split from the main Maya stem about the time the modern "Romance" languages were split from the mother Latin. A study of Mayance languages revealed that their



Science Service and the Maya Society

Hymn to the four gods, one of the Maya glyphic inscriptions which have been deciphered by Dr. Gates. His translations are: 1. Do honor and sacrifice (a turkey) in the North, to the White Lord, Wise Itzamna (at his task); 2. Do honor and sacrifice (an iguana) in the West, to the Black Lord, Wise Itzamna (at his task); 3. Do honor and sacrifice (a fish) in the South, to the Yellow Lord, Wise Itzamna (at his task); 4. Do honor and sacrifice (a deer) in the East, to the Red Lord, Wise Itzamna (at his task). These four are to be read vertically

structure and syntax were reflected in the glyphs and their arrangement.

Dr. Gates is now ready to say that Maya writing has symbols standing for things, like nouns, and others standing for names of actions, like verbs. These latter follow the Egyptian method of expressing action, as of a man walking or striking, or doing something. Then there are minor symbols that accompany and modify these main ones in various ways. Some appear to be adjectives, expressing such things as color. Others seem to be determinators or classifiers. Glyphs are also sometimes joined, expressing compound ideas as our word "[illegible]."

The Mayan language is not rebus writing, "like Aztec," as some have said. No instance of such rebus writing has ever been found in Mayan writing. In fact, Aztec was not rebus writing either, but picture writing, Dr. Gates explained, although some of the pictures were already partially abbreviated and conventionalized. The Mayan writing had gone further than Aztec. The original pictures had long heen "worn out," and had become "ideographs." Probably before America had been discovered, the original meanings of these had been lost, and "ideas" had become attached to them by convention.—*Science Service*

Synthetic Atmospheres

OXYGEN, since the time of Lavoisier, has been considered the vital component of the air. The remaining gases, comprising 79 percent of the air, have had little use assigned to them. It is, however, a problem of immense interest to learn what limits of variation can be tolerated by animals and also whether some changes from normal might be beneficial rather than harmful.

Carefully conducted experiments on this problem covering a period of eight years, have been carried out by Professor J. Willard Hershey, of the Department of Chemistry, McPherson College, McPherson, Kansas, and his assistants who have produced ange of "synthetic atmospheres" and noted their effects on animals confined in them.

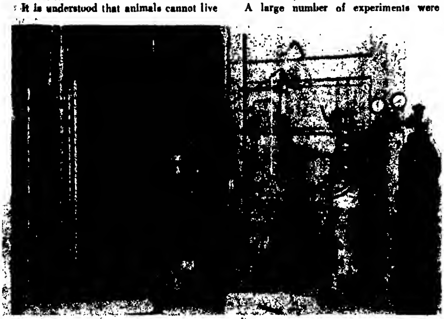
It is understood that animals cannot live in an atmosphere of oxygen alone, in nitrogen, carbon dioxide, helium, or argon. A series of 30 experiments using different varieties of animal life has shown that in an atmosphere of pure oxygen, with other conditions normal, life would cease to exist after two to five days.

One of the most surprising results of these experiments is that animals die in from a few to ten days when confined in an atmosphere composed of nitrogen and oxygen, the normal proportion, but without carbon dioxide and the rare gases, such as helium, neon, krypton, and so on. On the other hand, an atmosphere consisting of 79 percent helium and 21 percent oxygen permitted animal life to exist normally, or in some cases apparently better.

By using argon instead of helium and with the same percentage mixture the animals (mice) would not survive as they did with helium. The argon mixture would

diffuse through the living cells less rapidly than the natural air and the helium more rapidly, which might account for this difference. By decreasing the argon to 75 percent and increasing the oxygen to 25 percent, life was supported, so far as could be observed, better than in normal air.

A large number of experiments were



A contented kitten looks out into the world from a glass bottle into which is pumped the proper mixture of oxygen and other gases to keep him healthy

Courtesy Snead and Company

A new form of book cases for reference libraries. Being on rollers, it is claimed that it holds 50 percent more volumes than may be stored in stacks. The closed one at left protects against dust and fire

conducted with different mixtures of nitrogen and oxygen by varying the respective percentages. With these experiments as with some of those above, it was found that the animals not only survived hut appeared to be stimulated and benefited when the mixture contained from 40 to 50 percent nitrogen and from 50 to 60 percent oxygen.

In the field of practical application of synthetic atmospheres there is a wide range of commercial uses and values. In deep-sea diving, mines, and submarines, foul air is encountered and there is often a lack of sufficient pure air to sustain life. Aeronauts may carry a supply of prepared atmosphere aloft with them, and it may be provided for large factory and office buildings with more satisfactory results than when natural air from outside is used.

Medical men have a fair knowledge of the action of oxygen in the air, but little is understood by them concerning the other gases, especially the rare gases. It is possible that a knowledge of atmosphere may aid in the control of diseases. The widest field probably will be in pathological applications.

Sweet Potatoes May Yield Tasteless Stamp Glue

A TASTELESS dextrin inoffensive to lickers of postage stamps will have sweet potatoes as its source if experiments conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture are successful. In an oral statement reported in the *United States Daily*, H. S. Paine, Bureau chemist, told of efforts to obtain such dextrin from starch-producing plants of the United States.

The substance used at present comes from the lower grade of starch obtained from the cassava plant, grown chiefly in Java and Cuba. Several million dollars' worth is imported for this purpose each year. Many native starch-producing plants have been tried, but the dextrin has lacked

adhesive qualities or has been too bitter for the palate of the stamp-licking public.

The fact that between 10 and 30 percent of the sweet potato crop is rejected each year because the potatoes are either too large or too small for ordinary food uses offers a strong economic argument for

The self-propelled airship mooring mast at the Akron, Ohio, dirigible hangar

The Earth's Rainfall

EVERY day sufficient rain falls upon the earth to fill a reservoir 400 miles square depth of about 10 feet.—*Tycos-Rochester*

And Now for a Cold Cure

DOUBTS concerning the nature and cause of the common cold "have now been settled beyond all dispute" by the masterly investigation which Professor A. R. Dochez and his colleagues have conducted at the Johns Hopkins University in Baltimore. So says *The Lancet*, foremost British journal of medicine, in an editorial.

In an article in the same journal Dr. Dochez and his immediate assistants, Katherine C. Mills and Dr. Yale Kneeland, Jr., have described the findings of a piece of research which may ultimately lead to the discovery of a way of curing or even preventing an ailment too often regarded as minor but one which nevertheless accounts for immense loss of productivity. Dr. Dochez is a member of the faculty of the College of Physicians and Surgeons at Columbia University and his name has figured prominently in connection with many previous pieces of medical and biological research.

The findings indicate that the germ of the common cold is not the visible form of bacteria found when a cold exists but a smaller invisible filter-passing germ—one so small that it passes through the finest pores of porcelain filters, so small that it is not made visible under the strongest microscope. The visible form previously suspected of causing the ailment has now been assigned a secondary rôle; it is present when the other form is actively engaged in making you miserable, but apparently it is not the chief culprit.

The research which revealed the true culprit was performed first on chimpanzees, and then on human volunteers. Since this germ or virus cannot be seen, the only practicable way to isolate it is by passing the washings from the nose of a sufferer through a dense filter and inoculating new animals with the filtrate. It was satisfactorily established that the agent of the cold is a true "filter passer," a sub-microscopic germ, for those who were inoculated with the filtrate developed colds with consistency. In the experiments, this routine was repeated through 15 cultures—that number of volunteers being infected one by one, each from the last. It was calculated that the virus at the end of the series represented a dilution of 1 in two quadrillions, yet it remained active and capable of infecting a new victim with a cold.

Now that the cause of the cold has been hounded out of obscurity and its hide, as it were, nailed to the barn door, all that remains is to find a cure! This may prove more difficult. Yet—let the cynic say what he will—in science it nearly always holds true that, once a hidden cause has been uncovered, the cure soon follows, for research workers are no longer forced to fumble in the dark.

Self-Propelled Mooring Mast

THE Wellman Engineering Company, Cleveland, Ohio, has recently designed, built, and installed at the Air Dock of the Goodyear Zeppelin Corporation at Akron, Ohio, a mooring mast of the mobile type for handling rigid airships at the dock. The mast is designed primarily for outdoor service.

This mast is of the self-propelled type mounting the electric motors for its propulsion and steering. It carries a complete eight-cylinder gasoline engine driven Westinghouse generating plant for supplying power and lighting circuits. The structure comprises a three-sided pyramid, its base corners being located approximately 85 feet from each other, this arrangement permitting the crawlers to be equidistantly located on a 100-foot diameter circle. The height from the ground to the top of the mooring cup is 76 feet.

The machine is provided with the usual rigging for the "hauling-in" and other mooring lines; the apex of the tower is fitted with a mooring cup. This device is conically-shaped to receive the mooring cone carried on the nose of the airships. This cup is provided with a number of locking pins mounted on a rotating spindle fitted with anti-friction bearings, and having a hole to allow the passage of the "hauling-in" lines. Bell and spindle rotate in a housing especially designed to exclude dirt and moisture and secured to the corner posts of the framework. A circular platform is installed around and directly below the mooring cup.

The structure was proportioned to resist the horizontal pull produced by the largest ship riding against the wind in any direction, in combination with either an upward or downward wind load.

The triangular base of the framework carries the saddle castings on which the crawlers are mounted. Two of the crawlers are driven by a Westinghouse direct-current shunt motor which is operated by variable voltage or resistance control giving a wide range of traveling speeds in either direction, from "creeping" up to two miles per

Drive shaft to one of the driving crawlers of the mooring mast. A direct-current motor provides the motive force

The crawler with which the mast is steered is secured to a saddle casting on a swivel bearing with heavy king pin

hour. The front or steering crawler is secured to a similar saddle casting mounted on a swivel bearing with heavy king pin and arranged to swivel through a sufficient angle to permit turning in a reasonable space for ready maneuvering. This steering mechanism is electrically operated. The crawlers are spring mounted and equalized on the saddle castings.

The power plant is contained in a house of all-steel fireproof construction. The control cabin, of similar construction, is located on top of the house and contains all

The sequence of events is as follows: As soon as the submarine reaches the surface, the door is opened, and over a large slab of steel which falls flat in front of the hangar, rails are quickly laid, connecting those in the hangar with the end of the catapult rails. The aircraft is run out on this trolley and locked into position on the after end of the catapult. The submarine is turned into the wind and runs at a speed that will assist the take-off of the seaplane. The pilot of the seaplane opens the engine "full out" and when he

ning correctly, he

y; a stoker pulls

the release, operates the catapult, and by the time the aircraft reaches the end of its run, it has attained a high speed.

The cleanest sort of take-offs have been made in spite of the very short run provided. The pilot and the observer are naturally banged against the back padding in their cockpits but are still able to handle the controls with perfect precision. The submarine aircraft carrier should be of great help to any fleet.—*A. K.*

and motor so that there is the utmost flexibility in speed control.

The locomotive pulls a large beam to which the stern of the airship is held by yaw lines until the dirigible assumes a position parallel to the hangar. It is said that the locomotive in this position does work that could hardly be performed by 1000 men. A special feature of the design is that the height of the locomotive is only six feet from the top of rail. Moreover, its top is absolutely smooth so that there is no projection for the airship to catch on when swinging around the mooring mast. The hydraulic transmission of the locomotive permits absolutely smooth operation without jars or jerks. It would be a fine thing if this last feature were embodied in our ordinary passenger trains!—*A. K.*

A low, smooth-top locomotive to steer the *Akron* around its mooring mast

A Submarine Aircraft Carrier

WE have, in these columns, described small planes designed to be carried submarine and launched by hand from the upper deck into the water. The British have now gone a step further and have actually converted a submarine, the *M-2*, of some 1950 tons submerged displacement, into a regular aircraft carrier, fully equipped with catapult. The photograph shows a Parnell *Peto* emerging from the submarine, prior to its travel on the catapult. The seaplane is a conventional two-seater biplane with folding wings. No

rried.

the rear position

nt of him. When

in the "hangar" this little twin float biplane is locked upon the carriage resting on two rails. The large door in front of the hangar is raised mechanically. The men of the crew find but little room for working round the seaplane and are dressed in long waders.

A Dirigible-Handling Locomotive

ONE of the most important problems to be solved in making the airship practical lies in the task of ground handling. Strange to say, a locomotive comes to the aid of the airship. This locomotive, built for the Navy by the H. K. Porter Company, will operate on a circular track around the mooring mast of the airship, in front of the hangar at Lakehurst, New Jersey. The locomotive is powered with a 250 horsepower, eight-cylinder gasoline engine. The engine drives a hydraulic pump

The British submarine which has been converted to carry a seaplane. The seaplane just emerging from the deck hangar will be catapulted into the air

An Air Ferry for New York

THE main objection that hitherto has been made to the air transport services out of New York has been the time required to get to Newark Airport from various parts of the city and its suburbs. Now the Curtiss Wright Corporation has incorporated a new airline, the Metropolitan Air Ferry Service, which on regular schedule will connect Newark Airport with Floyd Bennett Field in Brooklyn and the Glenn H. Curtiss Airport on Long Island, thus bringing the two most important airports of the city within a few minutes flying distance of Newark and incidentally providing a splendid sight-seeing trip over Manhattan, Jersey City, upper New York Bay, Brooklyn, and Queens.

The flying time between each airport is less than 15 minutes and the new services are of course made to coincide with the schedules of the air liners. The airlines operating at Newark Airport enable one to fly anywhere in the United States within 30 hours. Even now, 10,000 passengers a month come in and out of this great air center. With this new ferry service there is no doubt that this number will be greatly extended.—*A. K.*

Photography During a Parachute Jump

EVERYONE wants to know how it feels to jump from a plane high in the air. The man who jumps can seldom describe his sensations after his parachute has brought him down safely. The strain of the descent disappears immediately and the possible look of concern is apt to give way to a broad grin of satisfaction.

Corporal Garland E. Kane of the Army Air Corps, Technical School Detachment, determined to take some pictures of him-

self in the act of making a parachute drop. If successful, the photographs would be a permanent record of facial expressions on the way down. A Brownie box camera, taking vest-pocket size pictures, was used. The only adaptations required were the soldering of an extension piece on the finger lever for easier snapping and the riveting of a ring for a lanyard to lessen the risk of losing the camera. Two of these cameras were fitted up.

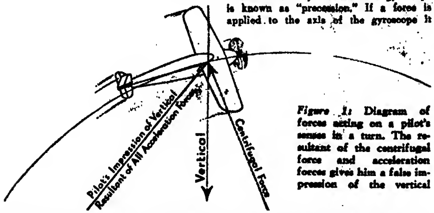


Figure 1: Diagram of forces acting on a pilot's senses in a turn. The resultant of the centrifugal force and acceleration forces gives him a false impression of the vertical

Corporal Kane jumped from a bomber at 4000 feet. He descended 800 feet before he was ready to take pictures of himself. He succeeded perfectly in taking eight snaps from arm's length, getting his face into each picture. The surprising thing about these pictures was that they showed a pleasant and confident expression in each case!—*A. K.*

The Aviator's Artificial Horizon

AN airplane pilot has three senses which are affected by the position of his airplane in relation to the horizontal: 1—His eyes which usually use the natural horizon as a reference; 2—His inner ear which is really a minute form of liquid level; 3—His deep "muscle sense" or the feel of his own weight.

If poor visibility prevents the use of the eyes to observe the natural horizon, it has been found that the deep "muscle sense" and the inner ear cannot cope with the problem of defining the horizontal. This is due to several causes; the most important of which is that a man's senses are taught to indicate the pull of gravity and he cannot distinguish between this and other forces such as centrifugal force. Figure 1 illustrates the point. The pilot is making a turn. The pull of gravity acts vertically downward as shown, but in addition to gravity, the centrifugal force comes into play and the pilot's impression of the vertical is the resultant of all forces and quite distinct from the true vertical. In complicated maneuvers and blind flying, therefore, the pilot's senses fail to help him.

Under the same conditions the ordinary liquid level also fails in the task of indicating the true horizontal because the liquid of the level also is susceptible to forces other than gravity. A pendulum fails for the same reason as the liquid level. The solution, therefore, must be the use of the gyroscope.

As shown in Figure 2, the gyroscope is a spinning mass universally mounted. If a free gyroscope were mounted in an airplane the axis would tend to remain rigidly pointed in the direction in which it was originally set, but the friction of the bearings and other forces would influence it, and the direction of the axis would gradually change.

The most important resultant of the forces which may influence the gyroscope is known as "precession." If a force is applied to the axis of the gyroscope it will move or precess in a direction at right angles to the applied force, as shown in Figure 2.

To maintain the gyroscope in a horizontal plane one possible solution is to hold it in place with a pendulum. Many attempts at making horizon instruments have depended on making the gyroscope pendulous. Every acceleration force acting on an airplane, however, will energize the gyroscope and cause it to "fall off" or precess in a

Figure 2: Pushing the gyroscope causes it to precess at right angles to the direction of the force

direction at right angles to the force applied. The pendulum, as it tends to pull the gyroscope back to the vertical again, causes precession at right angles to the pull. Due to this precession, the gyroscope will never return directly to the vertical, but will follow a spiral path, continually seeking the vertical but never coming to rest.

To make the gyroscope indicate the horizontal, and to insure its rigidity by eliminating the precession of the pendulous gyroscope, a form of "pendulum-controlled" gyroscope has been developed.

The gyroscope is mounted within an airtight casing and is rotated by two air jets, (drawn into the casing by suction from a venturi in the slipstream), which impinge on turbine blades on its periphery. The exhaust air is conducted to the lower part of the casing where four ports, spaced 90 degrees apart, divide the exhaust into four escaping air jets of equal volume.

Each of the ports through which these air jets escape is covered by a pendulous swinging vane which can enlarge or decrease the size of the orifice as it swings, thus increasing or decreasing the volume of the air jet which escapes. The normal position of these vanes, when the gyroscope is vertical, permits four equal air jets to escape, holding the gyroscope in position.

When the gyroscope tends to precess, due to acceleration forces, these vanes will alter the volume of one or more of the air jets so that their reaction force against the instrument casing will force the gyroscope to follow exactly the "vertical-seeking" pendulous vanes.

As shown in Figure 3, if a movement of the airplane causes the gyroscope to swing on its gimbal rings to the position illus-

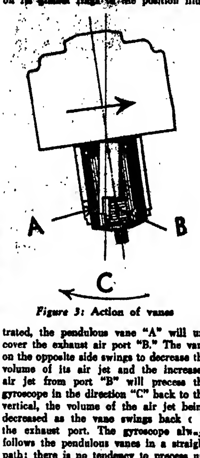


Figure 3: Action of vanes

trated, the pendulous vane "A" will uncover the exhaust air port "B." The vane on the opposite side swings to decrease the volume of its air jet and the increased air jet from port "B" will precess the gyroscope in the direction "C" back to the vertical, the volume of the air jet being decreased as the vane swings back over the exhaust port. The gyroscope always follows the pendulous vanes in a straight path; there is no tendency to precess unless it is caused by the movements of the controlling or dampening vanes.

It is this entirely novel development of the "pendulum-controlled" or "pendulum damped" gyroscope which has enabled the

Figure 4: The Sperry instrument to indicate the natural horizon

Sperry Gyroscope Company to produce an instrument, Figure 4, which will continuously indicate the natural horizon. We have mentioned and illustrated this device in the past, but this is the first time that details of its operation have been available.

The dial of the instrument has a white bar across it to represent the horizon. The dial also carries the silhouette of an airplane, viewed from the tail, which is used as a reference point. The position of the white horizon bar at all times corresponds with the position of the natural horizon. Index arrows are provided on the side of the dial to show when it is horizontal. For an illustration showing the various indications under different attitudes, see page 470, June 1930, SCIENTIFIC AMERICAN.

The Sperry Horizon has been entirely successful and is proving of inestimable value in aircraft blind flying.—*A. K.*

Front view of the *S-40* behind the smaller flying boat for comparison

The World's Largest Amphibion

IGOR SIKORSKY, of the Sikorsky Aviation Corporation, has been in the front rank of airplane designers for more than 20 years. In recent times he has increased his reputation by designing and building a series of splendid flying boats and amphibions. The latest of this series, the *S-40*, is the largest amphibion ever built. It has passed its trial flights in excellent fashion, and two amphibions of the *S-40* type are to be put in use by Pan American Airways in their South American service.

The *S-40* is a high-wing monoplane, powered with four Pratt and Whitney 575 horsepower Hornet engines, with the engines installed in nacelles supported from the wing. The wing spread is 114 feet; the overall length is 72 feet, 11 inches; and the gross weight of the ship is 34,000 pounds. The plane is capable of a top speed in excess of 130 miles per hour; and with a gasoline capacity of over 1000 gallons the *S-40* has a cruising range of 1000 miles. In spite of its enormous size, the draft of the hull is only 3 feet, and the ship can be landed in 6 to 8 feet of water.

While the principle of a retractable landing gear applied to a flying boat hull is not new, the gear employed on the *S-40* is remarkable by virtue of its size. The retractable gear is in two distinct units: each consists of a telescoping strut, hinged at its top to the upper part of the hull and attached at its lower end to the wheel assembly.

One of our photographs shows the amphibion gear down and the plane ready for land work. In the second photograph, which shows an artist's conception of the plane, the strut has been telescoped hydraulically and the wheel has swung outward and up so that it is completely clear of the water. Tests have shown the gear to be entirely satisfactory.

It will be noted that the tail surfaces are mounted on out-riggers so that the hull need not extend right to the tail surfaces of the plane. This makes for a shorter and lighter hull.

The flight of the *DO-X* and the discussion of a possible airmail service across the Atlantic have greatly revived interest in the possibility of trans-oceanic air transport. Flights in single-engined planes with one or two occupants at most, and with nothing but an overload of gasoline to carry, are now of but little interest. The true path of progress lies in building bigger and bigger flying boats, large enough to be seaworthy under difficult circumstances, capable of carrying many passengers in perfect comfort, with several men in the crew, and having every type of safety and navigational equipment.

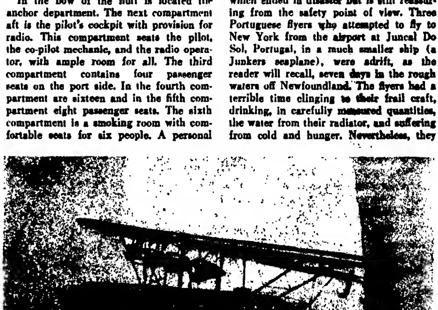
The artist's imaginative conception of the *S-40* is of the highest interest and keeps very closely to the actual design.

In the bow of the hull is located the anchor department. The next compartment aft is the pilot's cockpit with provision for radio. This compartment seats the pilot, the co-pilot mechanic, and the radio operator, with ample room for all. The third compartment contains four passenger seats on the port side. In the fourth compartment are sixteen and in the fifth compartment eight passenger seats. The sixth compartment is a smoking room with comfortable seats for six people. A personal visit to the *S-40* fully confirmed the artist's impression of the roominess of the passenger quarters. There is over seven feet of head room and the width of the hull is considerably greater than that of a Pullman car. A pantry, icebox, and room for extra storage space are provided.

Five hundred square feet of half-inch-thick sound-proof material under walnut panels are used to reduce noise to a minimum. Reading lights, ash trays, cigarette lighters, a call [illegible] for the steward, and individual ven[illegible] units, add to the comfort of t[illegible]. Here we have something [illegible] the ideal of airplane [illegible]

It is [illegible] how carefully seaplane [illegible] are [illegible] the question of sa[illegible]. Si[illegible] rafts are stored in t[illegible] located near the passenger entr[illegible] rear. Water-tight cov[illegible] from the ou[illegible] boat and rafts pulled out [illegible] compressed air bottles, stored in [illegible] attached to the rafts, supply [illegible]. The container has merely [illegible] overboard, the oars assembled [illegible] pocket in the raft, and the [illegible] is ready for service. With a capacity of five persons for each raft, a total of 30 passengers may be accommodated. Two similar rafts are placed in the forward part of the ship, accommodating the crew of five and the rest of the passengers. Emergency food is provided with each raft, as are also life jackets and furniture cushions that may be utilized as life preservers. All the furnishings of the ship are fire-proofed and automatic fire extinguishers protect each engine.

When we consider the reliability of the modern engine and the fact that four engines are provided, it will be seen that ocean flying in these large seaplanes is assuming at least a workable hazard. It might be interesting to recall a recent flight which ended in disaster but is still reassuring from the safety point of view. Three Portuguese flyers who attempted to fly to New York from the airport at Juncal Do Sol, Portugal, in a much smaller ship (a Junkers seaplane), were adrift, as the reader will recall, seven days in the rough waters off Newfoundland. The flyers had a terrible time clinging to their frail craft, drinking, in carefully measured quantities, the water from their radiator, and suffering from cold and hunger. Nevertheless, they



Artist's conception of crew and passenger accommodations of the *S-40*

stayed afloat for seven days. The *S-40*, with its greater size and additional equipment, could encounter a similar mishap with much less discomfort.—*A. K.*

Cooling the Cylinder Head

ONE of our photographs shows the new "E" type cylinder head now used on Wright Cyclone engines. The reader will note how carefully all parts of the cylinder head are finned for maximum cooling effect. Even spark-plug coolers, as shown at the center of the photograph, are finned

Maximum cooling effect obtained by use of a larger number of fins

for cooling. These spark-plug coolers are composed of bronze inserts of standard design, cast in one piece with aluminum alloy cups which are finned on the outside to provide cooling area for the inserts. It is to this careful attention to such details of design that we owe the increasing reliability of our aircraft engines.—*A. K.*

High Airspeed Records—Schneider Trophy

ON September 13 at Calshot, England, Flight Lieutenant J. N. Boothman won permanently for England the Schneider trophy with an average speed of 340.08 miles an hour. This average speed was made in seven times around the triangular course of 31.7 miles. On his first two laps he made an average of 342.9 miles an hour, thus setting a new world's record for speed for 100 kilometers (62.1 miles).

A third record was made by Flight Lieutenant G. H. Stainforth who broke the world's speed mark for a three-kilometer (1.863-mile) straight course with an average of 386.1 miles, more than 28 miles an hour better than Squadron Leader A. H. Orlebar's 1929 record of 357.7 miles an hour.

Shortly after the Schneider races, on September 29, Lieutenant Stainforth established a new airspeed record of 408.8 miles an hour. This remarkable record was the average of five runs over a three-kilometer course on the Solent at Calshot in an S6B seaplane. On his fastest lap, he made 415.2 miles an hour.

For this latter record flight, Lieutenant Stainforth had available, in a Rolls-Royce engine built especially for this trial, 300 horsepower more than has hitherto been available in this class of Schneider Trophy racing seaplane. Also, the fuel was a special blend of refined gasoline, wood alcohol, and tetraethyl lead.

Handling the "Akron"

THE *Akron* has passed its tests in a most satisfactory fashion. Once in the air, the airship is one of the safest flying craft possible, but undocking the *Akron* was not at all an easy task.

The ground equipment at the Goodyear-Zeppelin airship factory comprises two 10-ton side-handling cars, a taxi-wheel, a tail drag, more than a mile of railway tracks, and a great three-legged mobile mooring mast. The railroad tracks run on each side of the ship through a total of more than 5300 feet. On these parallel tracks run the heavy side-handling cars, with lines attached to the side of the ship to hold it steady against side gusts as it leaves the dock. On each side of the cars are mounted a drum and a capstan, with 1000 feet of cable wound on each drum. Thrust rollers extending downward below the top of the tracks enable the side-handling cars to withstand the largest cross-wind forces. The tail drag, a sturdy axle mounted on solid rubber tires and weighted down with a load of five tons, is attached under the ship as an anchor against upward gusts. It is the last piece of equipment detached before the take-off. The taxi-wheel is a great six-foot castored pneumatic tire. As the ship prepares to leave the dock, the side cars and tail drag are attached and the mobile mast moved to the ship at a speed of two miles per hour. The steel nose cone of the ship is locked into a huge metal cup at the top of the mast and the mast is again set in motion, towing the ship after it.

In the actual first handling of the *Akron*, the Navy crew prepared the most definite instructions to officers and men alike, with a rigid system of signals and commands. After the ship had been towed out of the hangar with the aid of rails and side car, the last command was "up ship." At this command the ship was released from the mooring mast and the men in the forward control car, used long poles with padded broad Y-shaped ends—called "crutches"—lifting the ship into the air by pushing with the crutches against the hand rails on the control car. The [illegible] car lifted it into the air and [illegible] with their hands as long as it could be reached. The ship, carefully balanced, left the ground as a free balloon without any of its motors running until it [illegible] altitude of about 200 feet. After the desired altitude has been attained, the [illegible] gines were started and the *Akron* may be said to have been definitely launched.—*A. K.*

New York to Washington in 68 Minutes

THE Ludington [illegible] New York, Philadelphia, Washington—have inaugurated a [illegible]

The service will, undoubtedly, be the fastest in the world. The plane shown in our photograph is a low-wing, seven-passenger transport, Lockheed Orion, equipped with a retractable landing gear and capable of a top speed of over 200 miles per hour. [illegible] the inauguration of a 68-minute service between New York and the Capital is [illegible] as an historic event!—*A. K.*

Carbon Mo[illegible] from [illegible]

ATTEMPTS to [illegible] illuminating gas from its content of carbon monoxide have been made for many years but so far have never produced a serviceable product of commercial utility, says a recent issue of *Gas Age Record*. The separation of the carbon monoxide not only increases the cost, but also alters the heating value of the gas so that a complete change of the consumers' burning appliances would be necessary.

It is announced that the Berlin Municipal Gas Works has lately succeeded, after long experiments, in removing the poisonous nature of the gas at a cost of only one-tenth of a cent per cubic meter. It remains to be seen whether this laboratory success can be equaled in large-scale commercial production.

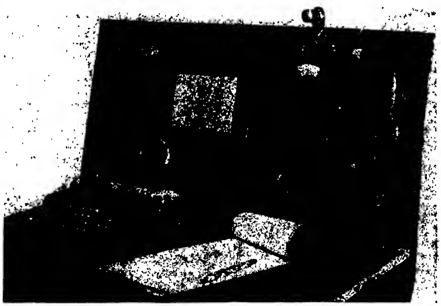
The experiments were a variation of processes already known; in particular, the gas was conducted across an iron contact heated to between 400 and 500 degrees Centigrade.

The seven-passenger plane used in a 68-minute New York-Washington service

the carbon monoxide being thus converted into carbonic acid and the water vapor reduced to hydrogen. The carbonic acid is then removed by washing the gas with water under pressure. At times another process is combined with this, so that methane and hydrogen are derivatives.—*A. E. B.*

Cooking with Cold

NOW that low temperatures have become available to the housewife through the introduction of the modern refrigerator people are becoming more interested in what may be termed "cooking with cold." As a result, many new desserts and chilled dishes have made their appearance on the dining table. A wider choice of foods is possible. This means better food, less waste, and more pleasure in life for the housewife. Health authorities are in accord that food, to be safe and free from bacteria, must be kept below a temperature of 50 degrees Fahrenheit. Cold is the conqueror of those tiny micro-organisms which cause food to spoil. The danger point is 50 degrees. When the temperature of food rises above that point while awaiting consumption, harmful bacteria multiply rapidly. Thus artificial refrigeration the year round becomes the only safe and satisfactory way to preserve perishable foods. A reliable thermometer should, therefore, form part of the equipment of every kitchen.—*Tycos-Rochester.*



The truck and trailer which made the record cross-country run, and below, its very complete instrument board

Motor Transport Across Country

IN order to obtain a record of the uniformity of performance of motor equipment over a long haul, a large truck with an equally large trailer, of the Southern California Freight Lines, Ltd., recently made a remarkable run across the country from Los Angeles to New York City in September. Leaving with a load of package freight on the fifth of the month, the truck and trailer stopped at several cities to unload part of their freight, and reached New York on the sixteenth, the running time for the 3200 miles being 117 hours. When the truck was finally unloaded it was found that the perishable freight in the refrigerated truck body was in a perfect state of preservation. No trouble was experienced on the way except for one puncture which was caused by a railroad spike. Engineers kept an absolute log of the trip every 10 miles by recording the readings of instruments in the instrument room which was combined with sleeping quarters just behind the driver's seat.

All stock equipment was used throughout. The chassis was a General Motors T-95, the engine being a Buick 525 of 135 horsepower. Weight of the truck was 23,060 pounds, and of the trailer 11,000 pounds. The truck body was refrigerated by a Frigidaire unit mounted, with its separate gasoline motor, behind the instrument room. This cold room was insulated against heat by means of Dry Zero blankets, a very light material made of the fiber from the pods of the ceiba tree. The trailer was attached to the truck with a Smith Safety Coupler, which is said to be simple and most efficient.

The entire unit was 52 feet long overall and was mounted on 22 tires, 10 of which were on the truck and 12 on the trailer. All wheels except the front steering wheels were equipped with Westinghouse-Bendix brakes. With these brakes, tests showed that the truck and trailer unit could be stopped in its own length when going at the rate of 30 miles an hour.

The equipment in the instrument room kept a check on the performance of 53 different parts of the unit. The instruments included thermometers, tachometers, hygrometer, gradometer, and various others for determining gas and oil consumption and so forth. For the trip of 3200 miles, the gasoline consumption totaled 1145 gallons and the oil used amounted to 13 quarts. The average speed was something over 27 miles an hour, and the average miles per gallon of gasoline 2.79.

This test run was made because the Southern California Freight Lines, Ltd., contemplate establishing a transcontinental freight service by truck. Colonel G. W. Davis, of the company, believes the demonstration fully warrants such operation. He says that the fact that the running time was less than five days is evidence that with motor transport equipment, package freight can be handled with a saving of five or six days over rail shipments, or as fast as express at freight rates. Incidentally, he expresses himself as unequivocally in favor of regulation of motor trucks by the Interstate Commerce Commission.

Total Weight of Atmosphere

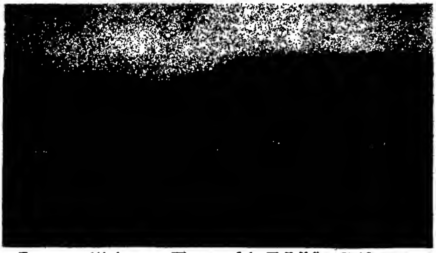
THE pressure of the atmosphere at sea level averages about 14.7 pounds to the square inch, which corresponds to a reading of 29.92 inches of the barometer. The density and pressure of the air decrease rapidly as we ascend. At an altitude of 3.6 miles above sea level they are reduced one half. The atmosphere extends, however, many hundreds of miles above the earth, becoming rarer and rarer with increase of altitude. Above six miles it is too rare to support life. Still higher it becomes more tenuous than the best "vacuum" we can attain with an air-pump. The total weight of the atmosphere is about 5,633,000,000,000,000 tons.—*Tycos-Rochester.*

Smallpox Menace

LARGE parts of the United States are in grave danger of epidemics of that horribly disfiguring and highly fatal disease, smallpox, members of the American Public Health Association were told by George H. Van Buren of the Metropolitan Life Insurance Company.

The fact that over half a million cases of the dreaded disease occurred in the United States during the period 1920-1930 came as a surprise to this important gathering of public health officials and authorities, in view of the fact that vaccination, sure preventive of smallpox, has been known for over 130 years.

The largest number of cases per thousand population was reported from the eight Rocky Mountain and the three Pacific Coast states. The fewest cases were found in the most densely populated parts of the



Trumpeter and black swans on Wintergreen Lake, W. K. Kellogg Bird Sanctuary

country, the New England and the Middle Atlantic states. These are the states in which public sentiment has been most active in supporting constituted health authorities in measures for the prevention of smallpox, Mr. Van Buren pointed out. "On the other hand, *the states where the incidence of the disease is high are those where opposition to compulsory vaccination has been strongest.*

"Until there is more general vaccination and re-vaccination, there will always be grave danger of severe and extensive outbreaks," he concluded.—*Science Service*

Saving the Trumpeter Swan

ALWAYS interested in conservation movements designed to preserve native species of birds and animals, we are pleased to present below a letter to the editor written by Mr. George Hebden Corsan, Sr., on trumpeter swans:

"It is more than 25 years since I wrote the SCIENTIFIC AMERICAN on the advantage of dredging the peat and marl from the lakes of Michigan, Wisconsin, and Minnesota, instead of draining them and the marshes.

"Again I call your attention to a most urgent conservation matter calling for immediate action. For the last four years I have been building the W. K. Kellogg Bird Sanctuary near Battle Creek, Michigan; when Mr. Kellogg gave the Sanctuary to the State College of Agriculture, my wife and I motored west to Whittier, California, to start ornithological and avicultural studies in connection with other work at Whittier College. On our way, we visited Yellowstone Park as I wanted to get first-hand information about the trumpeter swans reported as breeding there.

"On inquiring of the Park Rangers, I was told there are two pairs of trumpeter swans in the Park; that they are the only ones known to be in the country; and, further, there are only 50 live trumpeter swans left in the world. The Rangers advised me that one pair lays five or six eggs each year and the ravens eat the eggs. That pair doesn't even get a chance to hatch their young. The other pair raises from four to six young each year and the otters and eagles eat them as soon as they are mature enough to fly a bit.

"This is a terrible condition of affairs among the trumpeter swans. Park and Federal authorities must at once try other plans to save this most interesting of all our wild waterfowl. As a matter of fact, I consider the trumpeter swan the most interesting of all the world's game wild waterfowl! I say this after viewing alive some 85 varieties of wild ducks, and all the varieties of wild geese and wild swans. Consider that I left on Wintergreen Lake, at the W. K. Kellogg Bird Sanctuary, some 14,000 wild ducks, 100 wild swans, and 400 wild geese. Even the black neck swan of South America is not as interesting as our North American trumpeter swan (*Olor buccinator*), everything considered.

"The key to their successful propagation is domestication, for the trumpeter swan lends itself most readily to domestication, more so, in fact, than any other variety except the black swan of Australia which I have had frequently breeding twice a year. On the other hand, our whistler swan, *Olor columbiana*, the wild swan of today, is a most difficult bird to propagate in a domestic state. They will readily become quite tame but they refuse, so far, to nest, lay eggs, and raise young.

"We have allowed our whooping crane to be exterminated and the trumpeter swan is rapidly headed in that direction. Our wood duck, on the other hand, was saved by domestication. So was the muscovy duck. So were horses, cattle, sheep, pigs. Even fish are domesticated! Breeding fish under domestication has resulted in 95 percent of their eggs maturing, while only 5 percent of the eggs of wild cut-throat trout mature, according to Yellowstone Park authorities.

"If we want to save the trumpeter swans from extermination, we must at once trap the two pairs in Yellowstone Park, place them on a small favorable lake close to the coast, say, in the state of Washington, and take care of them so they will not be molested by their enemies. Canada should act similarly with the few remaining birds in British Columbia. By brailing the wings of adult birds and by pinioning the wings of young trumpeters while in the down, they can be easily domesticated, or semi-domesticated enough to save sufficient numbers to preserve the species.

"Barley, placed in water from one to two feet deep, will be all the feed they will require for trapping, or to feed them afterwards, as no wild waterfowl will distinguish between wild rice and barley. Wild rice is the most favored of all foods by ducks, geese, and swans.

"A gentleman in Holland has a pair of trumpeter swans which he secured many years ago, and which he breeds every year. From this pair I secured the trumpeter swans which are at present on Wintergreen Lake. Two pairs will be four years old next spring, ready to breed, and should breed, if all is well."

Administering Calisthenics

WOULD you like to have the benefits of golf without an effort? Exercise without leaving your arm chair? Keep physically fit despite broken bones? Maintain muscle tone even when encased in a plaster cast?

These things are made possible by a new electrical apparatus which causes graduated contraction of muscles. It has won the approval of the medical fraternity and is being used by hospitals to prevent strength from ebbing as a result of the inactivity of a patient who is recovering from illness or injury.

Prominent medical authorities have stated that an hour and a half of "exercise" with this apparatus is the physical

(*Please turn to page* 417)

Using the apparatus which administers calisthenics to a patient

"I'll see it through if you will!"

"THEY tell me there's five or six million of us—out of jobs.

"I know that's not your fault, any more than it is mine.

"But that doesn't change the fact that some of us right now are in a pretty tough spot—with families to worry about—and a workless winter ahead.

"Understand, we're not begging. We'd rather have a job than anything else you can give us.

"We're not scared, either. If you think the good old U. S. A. is in a bad way more than temporarily, just try to figure out some other place you'd rather be.

"But, until times do loosen up, we've got to have a little help.

"So I'm asking *you* to give us a lift, just as I would give one to you if I stood in your shoes and you in mine.

"Now don't send me any money—that isn't the idea. Don't even send any to the Committee which signs this appeal.

"The best way to help us is to give as generously as you can to your local welfare and charity organizations, your community chest or your emergency relief committee if you have one.

"That's my story, the rest is up to you.

"I'll see it through—if *you* will!"

—Unemployed, 1931

THE PRESIDENT'S ORGANIZATION ON UNEMPLOYMENT RELIEF

Walter S. Gifford
Director

COMMITTEE ON MOBILIZATION OF RELIEF RESOURCES

Owen D. Young
Chairman

The President's Organization on Unemployment Relief is non-political and non-sectarian. Its purpose is to aid local welfare and relief agencies everywhere to provide for local needs. All facilities for the nation-wide program, including this advertisement, have been furnished to the Committee without cost.

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

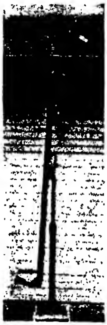
SO many descriptions of amateur's telescopes made from the instructions in the book "Amateur Telescope Making" have reached the editor that it has been necessary to crowd many into this month's number, to the sacrifice of a large portion of the interesting accounts of the jobs as sent in by the makers. However, here are a few fleeting glimpses of them.

The one below, made by Warren A. Donaldson, 3235 Gaylord Avenue, Pittsburgh, has a six-inch mirror. "When the polishing was complete," writes Mr. Donaldson, "I had the most unearthly figure imaginable." Much work reduced this to what a Pittsburgh professional telescope maker called "the best amateur job he had ever seen." The instrument has exceptional definition, and easily separates the double-double star in Lyra.

The telescope to the right of the last

Donaldson

one mentioned was made by William E. Mueller of Sutter, California, who says he commenced work all confident and expecting the job to be completed in a week or so. It took three months. The grinding consumed 12 hours, the polishing 25, and the figuring five. Eight laps were made. "Figuring was difficult, as per guarantee in 'Amateur Telescope Making,'" Mr. Mueller writes. "The cost was around 40 dollars. The rings of Saturn and any num-



Mueller

ber of other things seen. The effort was fully repaid."

Next, to the right, is a job by Walter W. Gaulka, 4203 Waverly Avenue, Detroit, who writes: "I had occasion to compare my instrument with a Zeiss four-inch refractor. In definition mine was on a par with it. At 92 diameters Jupiter's bands are very distinct." This worker used a flat for a diagonal and mounted it adjustably on a rack and pinion. The mounting was extemporized largely from old Hupmobile parts.

Below at the left is a six-inch reflector by Taylor Bethel of Southold, New York, who says "grinding and mounting a telescope mirror is the most intensely interesting work I have ever attempted. All work went smoothly until the silvering. I made three trials before I succeeded at that."

Rupert H. Olson, 3629 25th Avenue, Minneapolis, whose telescope is shown next to the right, writes briefly: "I ground several four-inch glasses from the five-and-ten store to get a little experience, so the eight-inch mirror was a small job to complete, by following the instructions in your book." Mr. Olson's method of preliminary practice is commended. That kind of approach to the job will pay in the long run.

H. B. Donahay, of Blake, Moffitt and Towne, paper dealers, Portland, Oregon, sends in a snapshot of his six-inch, and says: "I cannot agree with those who say that making a reflector is tedious. I enjoyed every hour of the work from grinding the mirror to assembling the optical train."

Gaulka

"The mirror proved to be a 'peach,'" says Oscar R. Knab, 309 South Monroe Avenue, Green Bay, Wisconsin. "It was made in the customary manner, and the usual pitfalls presented themselves. The results with this instrument, which cost me less than 13 dollars, are extremely gratifying. I am

Bethel

Olson

Donahay

Knab

Walden

now engaged on a 14-inch reflector."

M. C. Walden of the Mackay Radio and Telegraph Company, San Francisco, made ·scope partly by radio. That is to say, whenever he ran into a fix or "picklem· the work he telescope editor by radio, through a third person in New York, got his answer the same day, and applied it to that evening's work. He says he is satisfied with the job —as a first attempt. But he does not get the definition he would like. Has this anything to do with San Francisco atmospher telescope ed's radiod shaky?

e teachers find telescope making just the thing. E. E. Gale, instructor in "math" and physics in the Port Perry, Ontario, high school, assisted by his students, made the telescope shown. He appears to be enthusiastic about the work. His mounting is cast into a base which doubtless "stays put" pretty well—a big glacial boulder. This reminds us of the biblical wise man who built his house upon a rock. "And the rain came, and the wind blew and beat upon that house and it fell not, for it was founded upon a rock." Is our quotation (from memory) correct? We can't find the original.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

AIRPORT DESIGN AND CONSTRUCTION (Aeronautics Bulletin No. 2) is a valuable contribution to the subject giving attention to the problems of municipalities, terminal facilities, airport planning and construction, airport lighting, servicing equipment, roof marking, et cetera. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis*

TREND IN AIRPLANE DESIGN AS INDICATED BY APPROVED TYPE CERTIFICATES (Aeronautics Bulletin No. 21) gives the result of recent investigations and the substantial changes made by manufacturers. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

CONVEYOR ELEVATOR (Catalogue C-37) gives full particulars as to a method of economically conveying liquids as well as coarse, fine, and granular products, dry or moist. Tables and a classified list of materials to be handled are included. *Bailey-Burruss Mfg. Company, Atlanta, Ga.—Gratis.*

INVESTIGATION OF VARIOUS FACTORS AFFECTING THE HEATING OF ROOMS WITH DIRECT STEAM RADIATORS (Bulletin No. 223) by Arthur C. Willard, Alonzo P Kratz, Maurice K. Fahnestock, and Seichi Konzo describe experiments conducted and results obtained. It is a valuable monograph giving unique studies. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—55 cents.*

ANNUAL REVIEW OF LEGAL EDUCATION IN THE UNITED STATES AND CANADA FOR THE YEAR 1930 by Alfred Z. Reed takes up such subjects as responsibility for inadequate bar admission requirements, different types of law schools, the check in the growth of evening law schools, and the lengthened period of preparation. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

PAPER SEALING TAPE (Bureau of Standards No. R 114-30) deals with a simplified schedule of widths and lengths of rolls of plain and printed tape. This material is of considerable importance, particularly for sealing fiber and corrugated shipping containers. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

SERPENT WORSHIP IN AFRICA (Anthropological Series Vol. XXI. No. 1, Publication No. 289) by Wilfrid D. Hambly gives a survey of Africa in relation to the nature, distribution, inter-relationship, origin, and migration of serpent cults, worship, and belief. It is a monograph of great interest to those studying anthropology. *Field Museum of Natural History, Chicago, Illinois.—75 cents.*

TO make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

CHEMICAL INDUSTRY AND TRADE IN POLAND (Trade Information Bulletin No. 762, Department of Commerce) by Clayton Lane presents all available information in connection with Polish production, imports, and exports of chemicals. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

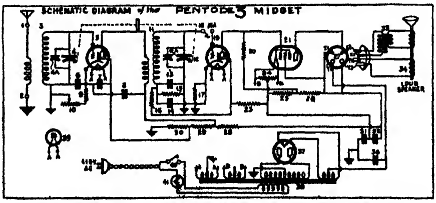
PRESENT AND IMPENDING APPLICATION TO EDUCATION OF RADIO AND ALLIED ARTS (Information Series, No. 5) by Levering Tyson presents information of great value, a knowledge of which would prevent much misconception of the entire subject. For example we learn that a 1000-watt station costs 44,900 dollars capital investment while a 50,000-watt station costs 338,000 dollars. *National Advisory Council on Radio in Education, 60 East 42nd Street, New York City.—Gratis.*

THE PROGRESS OF AMERICAN CHEMISTRY SINCE THE OUTBREAK OF THE WORLD WAR (Reprint, *Industrial and Engineering Chemistry*, Volume 23, January 1931) by William A. Hornor and Lawrence W. Bass gives a table, showing year by year, notable chemical discoveries and inventions, the beginnings of the manufacture of new chemical products of importance, and outstanding changes in established chemical manufactures. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

WHAT NEW YORK'S TELEPHONE MEANS TO NEW YORK by James L. Kilpatrick is a lecture given before the School of Engineering of Princeton University and is replete with interesting diagrams and illustrations showing some of the engineering problems which must be solved. *New York Telephone Company, 90 West Street, New York City.—Gratis.*

THE SEDGWICK AUTOMATIC BRAKE INVALID ELEVATOR describes a great boon to the sick and those for whom stair climbing is dangerous It makes the whole house available to those who have heretofore been confined to a single floor. Such elevators can be readily installed in existing houses. *Sedgwick Machine Works, 150 W 15th Street, New York City.—Gratis.*

GLOSSARY OF BOTANICAL TERMS COMMONLY USED IN RANGE RESEARCH (Miscellaneous Publication No. 110, U. S. Department of Agriculture) compiled by W. A. Dayton is an exceedingly valuable pamphlet with a wealth of definitions and many illustrations. *Superintendent of Documents, Washington, D C—15 cents (coin).*



Those radio enthusiasts who like to build their own sets will be interested in the Pentode Midget Three, shown in the above schematic diagram, which is so compact that it can be housed in a cabinet formerly used for a standard dynamic speaker. The circuit consists of a tuned radio-frequency stage using a type 551 variable mu tube, a 124 screen-grid power detector, and a single audio output stage using a PZ power pentode. The control grid of the pentode is directly coupled to the plate of the screen grid detector, using the Loftin-White system. Canoid coils add to the efficiency of the circuit. A new-type midget dynamic speaker is another feature of the receiver. This little set is very powerful, has lots of volume, and is amply selective. Further details and a complete set of diagrams and views can be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York City—3 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 412)

equivalent of 36 holes of golf. It has been used with great success in the treatment of stiff neck, lumbago, and charley-horse.

Arms or legs, held motionless in plaster casts while recovering from injury or operation, need no longer emerge weak and powerless from lack of exercise. At the St. Francis Hospital, Pittsburgh, idle muscles are "exercised" by flashing interrupted electric currents through them, causing rhythmic contractions, a small Westinghouse motor driving the interrupting mechanism.

Tired business men, overworked executives, hurried socialites and others may, in the future, choose to take their exercise electrically with this new apparatus. It may bring us a step nearer to the synthetic living that has been predicted by many.

Food from Coal

INSTEAD of depending upon meat for the protein of his diet, man may eventually get this essential food element from coal. At least, German chemists have proved to their own satisfaction that coal chemistry has already advanced to the point where, by technically practicable processes, it is possible to obtain directly from coal and coke such substances as are used by nature in the synthesis of the animal and human body.

Work in this direction has been prosecuted in the Gesellschaft für Kohlentechnik for more than a decade, and it has bridged the gap between chemicals and the materials occurring in coal, which falls within the range of protein formation. One cannot at present imagine artificial subsistence, but surely a definite direction is being marked in this field, and it is shown that the production of albuminous materials from a coal base is ready to be disclosed.—*A. E. B.*

Average American Chews 109 Sticks of Gum a Year

CHARACTERIZING the inferior social status of shop-girls by their gum-chewing proclivities is now but the sign of an outdated novelist. Per capita consumption of chewing gum in the United States has risen to well over 100 sticks a year, three times the 1914 figure. In 1929, factory value of the production of chewing gum was almost 60,000,000 dollars and retail value of that sold in the United States is estimated at 114,000,000 dollars.

Even more rapid than the rise in home consumption has been the increase in exports. Ascribed in large measure to its introduction into Europe by the American soldier, chewing gum exports have increased in value from less than 200,000 dollars in 1914 to about 1,500,000 dollars last year.

The basic gum entering into the manufacture of the product is chicle, obtained by coagulating the latex of the sapota tree, *Achras sapota*, a native of Central America. The largest part of the gum comes from the southern part of Mexico, particularly Yucatan. The trees average 75 feet in height,

with a diameter of 34 to 40 inches and yield about 5 pounds of chicle per tree. As the trees are tapped again only after the previous incisions have healed—a five- to eight-year interval—the average annual yield per tree is less than a pound.

The milky juice is heated until the milk coagulates into a compact mass. Molded in blocks for export, the crude gum contains about 50 percent water and other foreign [illegible] the gum has been one of the more difficult steps in the manufacturing operation.

Thirteen pounds of chicle as it comes from the final purification ordinarily will make about 5000 standard pieces of stick chewing gum. For export purposes, packets of six sticks are in demand, rather than the five-stick packet common in domestic trade. —*A. E. B.*

Hail Sometimes Kills

THOUGH hailstones of large size frequently fall in the United States, it is not often that people are killed by hail here. But India often has hail of sufficient size and violence to kill people. In a remarkable storm which occurred on April 30, 1888, in a region about 100 miles east of Delhi, nearly 250 persons were killed, principally by hail. In a near-by district 16 more persons were killed by hailstones, during the same storm. One day during the summer of 1930, hailstones falling in Greece killed 20 persons and injured more than 40.—*Tycos-Rochester*

An Amplification of Ten Quadrillion Times

A DEVICE which amplifies an electric current 10 quadrillion times was exhibited recently by E. S. Darlington of the vacuum tube engineering department of the General Electric Company at the radio and electric show of the Electric League of Washington. The device is a low-grid-current tube which, in conjunction with a Thyratron tube, is capable of utilizing 0.00000000000000001 (10^{-17}) ampere to control 0.1 ampere—100 milliamperes—directly. The grid cap or terminal of the tube which picks up these minute charges from space is smaller than an ordinary thimble.

As a means of demonstrating the remarkable sensitivity of the low-grid-current tube, Mr. Darlington utilized the relatively small amount of current generated by rubbing an amber rod with a piece of paper to turn on and off a usual incandescent lamp, with the amber rod at varying distances of from 5 to 15 feet from the small box on which the sensitive tube was

E. S. Darlington of the vacuum tube engineering department, General Electric Company, demonstrating the great sensitivity of the low-grid-c

mounted. On the front of the box was a [illegible] h showed plainly to what degre the tube was being affected by positive and negative charges obtained by rubbing the rod. Connected to the box was another one, on top of which were mounted a Thyratron tube and incandescent lamp. Current was supplied to the lamp by the Thyratron tube; the minute charge from the amber rod was amplified by the low-grid-current tube sufficiently to operate the Thyratron tube and turn the lamp on or off according to whether the charge was positive or negative. A current of 10^{-17} ampere thus directly controlled the 0.1 ampere used by the lamp—introducing an amplification factor of ten thousand million million times.

Gold Production Rises Due to Placer Mining by Jobless

DESPITE the substantial reduction in the mining of complex ores, from which is derived a large part of the gold output, the production of the yellow metal during 1930 was considerably greater in the United States than in the previous year, due to the increased activities of individual prospectors working with pick and shovel in placer deposits, according to information released by the Department of Commerce.

There has also been an increase in the production of scrap or secondary gold which, together with the gain in new gold output, has made available the largest supply of the metal for currency purposes in many years. The following additional information was furnished by the Department.

Gold production during 1930, based on arrivals at the United States mints and assay offices and at private refineries, was estimated at 2,285,603 ounces valued at 47,247,600 dollars, an increase of approximately 1,600,000 dollars over 1929. These figures include the output in Alaska and the Philippine Islands.

Economic conditions have stimulated gold prospecting in the United States during the last two years. Some months ago the President's Emergency Committee for Employment issued a statement which told of the activities of unemployed miners in Nevada and other states in placer operations. It was estimated that hundreds of jobless had taken to the pick and shovel—in some cases machinery was supplied—in an effort to earn a few dollars in the pursuit of the precious metal. In some cases the owners of large claims had thrown their lands open to the unemployed.

Along with the increased activity in gold staking and the resultant added supply thus made available, there appears to be a larger production of secondary gold, which comes from jewelry, art goods, dental work, and so forth, which has been turned into the melting pot. The output of secondary gold in 1929 amounted to approximately 24,000,000 dollars. The figure for 1930 is not yet available but it is believed will show an increase of about 2,000,000 dollars.

Being used principally for currency or ...e of gold remains stable. The average value of the metal in 1930 was $20.671835 per ounce and in 1929 it was exactly the same amount. Silver, on the contrary, averaged 38.5 cents per ounce in 1930 and 53.3 cents in 1929. It is natural, therefore, that those deposits which are in any way promising be exploited to the utmost.

The major part of the domestic supply of gold has come from complex ores in which the yellow metal forms an incidental but important proportion. It is found in combination with silver, copper, lead, and ... with the nature of the ores.

Because of the reduced demand for these ...etals, a ... production, there has necessarily been a decline in the gold output, as it does not often pay to treat tons of these ores solely for the gold they contain, although the gold is decidedly worth recovering during regular operations.

An interesting illustration of the effect of reduced mining operations on the production of gold is seen in the case of Arizona. In 1929 silver production in this state totaled approximately 7,500,000 fine ounces but in 1930 the output fell to approximately 5,550,000 ounces.

Copper production in this state fell from approximately 830,000,000 pounds in 1929 to 576,000,000 pounds in 1930. The reduced output of these metals is reflected in gold production which declined from 202,318 fine ounces in 1929 to 169,390 fine ounces in 1930. It is to be noted, however, that the amount of ore treated in Arizona declined from about 26,000,000 short tons in 1929 to about 20,000,000 short ton in 1930 and that there were 342 producers operating in 1930 as against 412 in 1929.

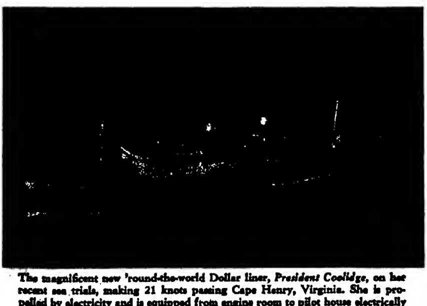
Gold was produced in 1930 in 18 states, Alaska and the Philippines. California produced more than 9,000,000 dollars worth, Alaska and South Dakota more than 8,000,000 dollars worth, Colorado and Utah more than 4,000,000 dollars worth. Next in importance were Philippine Islands, Ari... Nevada, Montana, New Mexico, Idaho, and Oregon. Small quantities also came from Alabama, Georgia, North Carolina, Pen...sylvania, Tennessee, Texas, Washingto... and Wyo...

The Union of South Africa (Transvaal, Natal, and Cape Colony) produces about half the world's gold supply. Along with Australia, Canada, and Russia, its production has been increasing while the rest of the world has been declining. Whether the increased output in the United States represents a trend cannot yet be determined.—*United States Daily.*

Chemical Preservation of Wood

THE chemical treatment of wood to pre... sects has become so widespread that the wood preserver is beginning to wonder ... the anomalous position of being injured by his own success. If treated wood lasts from three to five times the life of untreated wood, can the market continue indefinitely? asks a writer in *Chemical Markets*. The answer to that question depends upon the ingenuity of the wood preserver in creating new markets for treated wood.

There are many possibilities for treated wood, and their development will have a



The magnificent new 'round-the-world Dollar liner, *President Coolidge*, on her recent sea trials, making 21 knots passing Cape Henry, Virginia. She is propelled by electricity and is equipped from engine room to pilot house electrically by Westinghouse. She is the largest electric ship in the world at present and the largest commercial ship ever built in America, her tonnage being 33,800

tremendous influence on the future of wood preservation. Just as markets for treated wood were built up largely by the demands of the railroads for treated ties, so now they are being affected adversely by the lessening demand for treated ties resulting from decreased tie renewals. Many railroads now use only treated ties, and on one railroad tie renewals per year decreased from 336 per mile to 48 per mile in a period of 19 years. That this reaction is being felt in the treating industry is evidenced by the tendency of treating companies originally concerned chiefly with treatment of ties to turn now to treatment of other forms of timber also.—*A. E. B.*

Chromium in the Battle Against Corrosion

ONE of the major metallurgical problems that has never been solved satisfactorily is that of corrosion. In almost every industry there is some material that has a corrosive effect on metal parts. Acid mine waters take their yearly toll of rails, pipes, pumps, and valves. Salt water, rust, and atmospheric oxidation cut down the life of exposed steel on ships and structures in general. Boiler plates, fire tubes, fire box sheets, and stacks are eaten away by the corrosive gases with which they come in contact. The innumerable acid and salt solutions encountered in the chemical and dye industries soon cause the parts of apparatus through which they pass to be relegated to the scrap heap. Oil refineries find it necessary to replace cracking plant equipment continually. In the automotive fields much difficulty in the past has been encountered in the corroding of valves, pump shafts, and so on, and the rusting of bumpers and trim after the surface of the nickel or chromium plating has been broken. This list is but a small portion of the applications open to some inexpensive corrosion-resistant metal.

It appears that the chromium and chrome-nickel series of alloy steels have made the nearest approach to filling this demand in its entirety. Not that one certain type of chrome or chrome-nickel steel will completely cover the corrosive field from acid-resisting pumps to high-temperature high-strength fire box sheets, but, by varying the percentage of the alloying materials it is possible to impart to the steel physical properties most suited to the specific type of work.

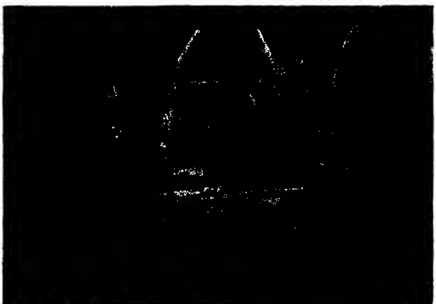
Chromium has a very great affinity for oxygen. It is this property that, peculiarly enough, gives it its corrosion-resisting quality. This paradoxical statement can readily be explained by the fact that the oxide formed is practically impervious and very stable. According to Mr. E. C. Bain, of the U. S. Steel Corporation, it is believed that a thin film of this oxide is formed as soon as the metal becomes exposed, and that this invisible film acts as a protective coating against further oxidation and corrosion. This property of self-protection, furthermore, is bestowed upon its solid solution in steel when the percentage of chromium is high enough.

Chromium tends to combine with the carbon in steel to form a carbide that is not corrosion resisting. Therefore, to retain this highly desirable property it is necessary to introduce a sufficient amount of the alloy to distribute a solid solution of chromium and iron throughout the piece after the carbon content has combined with a correspondingly proper amount of chromium and destroyed the corrosion-resisting qualities of the alloy to that extent.

In the lower ranges of chromium such as are found in the so-called stainless steels, the chromium imparts to the steel air hardening properties. Where carbon steel must be quenched in water to be hardened, stainless steel, if heated above its critical range, will harden if allowed to cool in air.

The addition of nickel to chromium steels lowers the critical temperature, so that the tendency of the solid solution of the alloys and iron to decompose is reduced. These alloys are fine grained in structure, and are strong, tough, and ductile. They work-harden very readily, making them highly resistant to abrasive wear.

In the chemical industry, innumerable applications for all varieties of chromium and chrome-nickel steels can be found. The



Courtesy [illegible]

A few samples of alloy steel parts that are used to combat corrosion in the following industries: petroleum refineries, steel (in the pickling bath), food handling equipment, dye preparation, air conditioning, and food preparation

high chromium, nickel-free alloys are used when strength at high temperatures and resistance to oxidation, or resistance to sulfides is desired. Chrome-nickel gives greater strength at elevated temperatures. The addition of other elements such as tungsten, copper, and silicon further widens the field for resistance against certain corrosive liquids and gases.

In the automotive fields, stainless irons having a typical analysis of: carbon, 0.12 percent; chromium, 12-14 percent; and maximum silicon, 0.50 percent are used for nuts, bolts, bumpers, and so on. Body trim such as radiator shells, headlights, cowl beading, and fittings are frequently made from 18-8 chrome-nickel steel. Valve steels containing 9 percent chromium and 3 percent silicon are becoming more prominent because of their heat-resisting properties. Carburetor needle-valves, pump shafts, and all parts where greater hardness or strength than can be found in the stainless irons is desired, may be fabricated from stainless

Courtesy Field Museum of Natural History

The world's largest X-ray picture seven feet by two feet

steels containing about 0.30 percent carbon and 12 percent chromium.

These applications are but a few of those that could be mentioned; but they help to illustrate the many uses to which chromium and chrome-nickel alloy steels may be put in the great battle of the industries against

A. E. B.

Seven-Foot X-Ray Picture

AFTER a long series of experiments, a new departure in X-ray work has been ———, made in the division of roentgenology at Field Museum of Natural History, resulting in what is believed to be the largest X-ray picture ever taken, it was announced recently by Stephen C. Simms, director of the museum.

Some of the new scuffless shoe heels made of Pyralin as described in our October issue. As may be noted, besides imitating reptile skins with this chemical substance, standard finishes may be obtained

It is expected that this development will mark the opening of a new chapter in X-ray achievements, the possibilities of which for application in various fields cannot yet be definitely determined, but which appear to be very broad, according to Director *Simms.*

The first roentgenogram of this large type has for its subject one of the museum's Egyptian mummies, and has been ... ong by t ... wide, which would be ... for ordinary photography. This film represents the first successful effort ever made to photograph an entire adult mummy in its casket on one film, and with only one exposure, it is stated by Miss Anna Reginalda Bolan, who is in charge of the museum's X-ray laboratory. So far as can be learned from any available authority, it is also the largest roentgenogram ever made anywhere of any subject. The film is remarkably clear in showing anatomical and other details, and Miss Bolan, through whose efforts the work was successfully carried out, claims it possesses great value from the diagnostic standpoint.

Heretofore mummies have been X-rayed at the museum in sections on the regulation size film, 14 by 17 inches. These smaller films were then pieced together and from this "mosaic" the specimen was viewed and its anatomical relation to cartonnage and casket estimated. The advantages of being able to X-ray so large a subject on a single large film are obvious, assuring greater accuracy and reducing the amount of work involved.

The museum's roentgenological laboratory was established and equipped about five years ago by Stanley Field, president of the museum. Special apparatus was recently built and installed to produce the new type of

Excess Fat of Body Changed into Sugar

IF you eat too much fat and not enough sugar, will your body automatically transform some of the excess fat into carbohydrate fuel food? Dr. John R. Murlin ... the University of Rochester has suggested that the versatile human body thus answers its own demands for proper food by manufacturing the needed sort even if the raw materials fed it are not just what are needed.

Volunteers lived on a diet of pure cream

for five days in the experiments reported to the Federation of American Societies for Experimental Biology by Dr. Murlin and Miss Estelle E. Hawley, his associate. Each morning and evening they were fed their meals of cream and then they were put through tests to ascertain how the body used this unbalanced food ration. One brave temporary martyr to science remained in an ice box for an hour and a half in order to test his metabolism on the fat diet under the influence of reduced temperature. He shivered for an hour during this experience.

Sufferers from diabetes seem to be able to eat fat without filling their blood with sugar that is dangerous to them. This has caused physiologists to believe that the body could not manufacture sugar or other carbohydrates from fatty foods.

Physicians have recognized heretofore that sugars could be converted into fat by the body and they have repeatedly warned pleasingly plump people against eating too much sugar and starches. Now, if Dr. Murlin's experiments are further confirmed, they can feed their obese patients high fat diets in necessary cases with the assurance that the body will look out for itself and make the sugar that it needs to supply its energy.—*Science Service*

Start Early to Salvage Deafened Child

URGENT need of discovering defective hearing in very young children, and of salvaging what hearing they have before it is lost forever, was brought out recently by Dr. Richard O. Beard of the University of Minnesota.

The child of today, in the first five years of his life, is surrounded by a world more varied and stimulating than babies have ever before experienced, Dr. Beard declared, and babies have become more precocious in their development in consequence.

"Watch the baby of today in his reactions to the electric door or telephone bell," he said, "or to the flash of electric light, to the sight and touch of his many toys, to the taste and odor of his varied diet, to the vocal attentions of his family and his ubiquitous friends."

In this speeding up of mental and emotional development, hearing plays the major rôle, the speaker continued. The young child whose hearing is even partially impaired needs to have intelligent first aid as soon as the handicap is discovered.

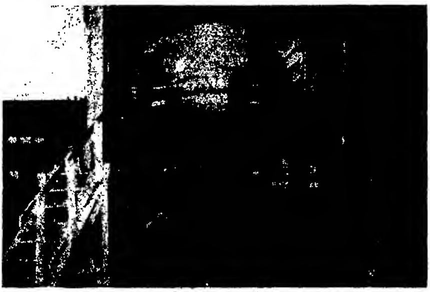
The tendency of parents to try to hide the fact of a child's defective hearing was deplored by the speaker, who said that such a policy robs the child of a start in life.

Physicians are coming to doubt whether more than a very small percentage of young deafened children are totally stone-deaf, Dr. Beard continued, and a residue of hearing, even though small, may be put to good use in teaching the child to use its voice, to use what hearing it has, to read the lips, and to live a more normal social life. But if the remnant of hearing is not salvaged by proper educational methods, the child who cannot hear distinctly may lose the habit of listening at all, and with disuse the organs of hearing become still further impaired.—*Science Service*

Ball Tank for Shipping Helium

THE punishment inflicted on a baseball by the bat of "Pepper" Martin or "Babe" Ruth fades to insignificance when compared to the gruelling ordeal to which engineers of the A. O. Smith Corporation, of Milwaukee, Wisconsin, recently subjected the huge chromium-steel ball illustrated here. This ball is really a storage tank designed for the shipment of compressed helium which the United States Navy uses to inflate its dirigibles.

The idea of using spherical containers for the transportation of gas under high pressure was conceived by the A. O. Smith Corporation, and a tank car, based on this idea, was developed for the Navy. This new type of car carries six spherical containers capable of transporting 210,000 cubic feet of free helium at a pressure of 2000 pounds per square inch. The spherical container has the inherent advantage of being approximately 25 percent lighter than a cylindrical container of the same capacity. It also is much simpler in design and construction if made of two formed heads welded together.



The helium shipping sphere set up for the repeated hammer test

The tests illustrated here were made on a chrome-vanadium sphere 94 inches inside diameter and $1^{11}/_{16}$ inches minimum wall

thickness. The results definitely established the practicability of this unique form of container and proved that both the steel and the welded joint were far stronger than required by the Interstate Commerce Commission's exacting specifications.

The test consisted of three parts: repeated hammer test, single blow impact test, and pressure test to failure. Before these tests, the sphere was subjected to the customary acceptance test involving hammering the seam under a pressure equivalent to 60 percent of the yield point and a final test at 80 percent of the yield point. At failure the tank had expanded 8.1 cent.

The vessel was filled with water under pressure of 34,200 pounds per square inch. It was hammered continuously for 75 hours, equivalent to a total of 35,000,000 blows, each of five foot-pounds energy.

The single blow impact test consisted of dropping a "skull cracker," weighing 1718 pounds on top of the vessel from a height of 23.5 feet while the vessel was under the water pressure. The blow had an energy of 30,000 foot-pounds. The weight was dropped on the apex of the sphere (thinnest portion) and made a dent one fourth inch deep. Then the vessel was turne around and the weight dropped on th weld, making a dent three sixteenths of a inch deep.

For the destruction test the vessel wa covered with lime wash to show first point of deformation. It was found that the yield point was reached at a stress of 59,200 pounds per square inch. The vessel failed at a pressure which was equivalent to a calculated ultimate strength of 83,400 pounds per square inch. The vessel broke in a number of parts, as shown in the picture, and it has been calculated that the total energy in the vessel at the time of fracture was 2,500,000 footpounds.—*A. E. B.*

All that was left of the helium sphere after the destruction test

Natural Gas Fuel for New Engine

FOLLOWING the widespread distribution of natural gas, a Minneapolis implement company has placed on the market a low-speed, heavy-duty internal combustion engine, to use the new fuel.

The new engine, said to be the first of its kind to be manufactured for commercial use, is being successfully employed in cotton gins of the Southwest. It is especially adapted to slow moving stationary machinery, and its makers claim unusual economy where natural gas is available.

It is a modification of a type of slow-speed motor built to use kerosene or gasoline fuel. Instead of the 1500 to 3000 revolutions per minute usually developed by the ordinary internal combustion motor, the natural gas motor has a range of about 800 to 1000 revolutions per minute.

Television "Sputtering" Reduced

IN the neon lamps used in reprodu television pictures, the metal plate tends to throw off minute particles of itself which blend with the gases, states Hollis Baird, chief engineer of the Shortwave and Television Corporation. The ultimate result of this action, called "sputtering," is that the pictures grow dimmer and dimmer since impedance of the tube goes up as the il goes off, and the glass of the tube tena as well.

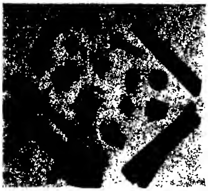
luminum, tungsten, and tantalum have a low sputtering characteristic, but tungsten and tantalum are too expensive for general use and aluminum is too soft. Copper, gold, silver, and lead have a sputtering factor of from 75 to 100 times as much as these other metals, making their use impossible. The best solution of the sputter problem has been the use of common iron. Iron has but five times the sputtering characteristic of the good metals, compared with the 75 and 100 of the other metals named above.

Discovery of these facts is now permitting the design of lamps for television which have a long life and which give a steady light during this long period, and which need not be too expensive to make. Thus in solving the "sputtering" problem, better pictures are assured.

Borax King Ends Colorful Career

WITH the death on August 27, of F. M. Smith, known as "Borax" Smith, the chemical industry lost one of its most picturesque personalities. Mr. Smith, who was 85, once possessed a fortune estimated a many millions, but died a relatively poor man. Forty years ago, Smith was a miner, picking at mineral pockets here and there, sleeping under the stars wherever night chanced to overtake him, oblivious to hunger.

After wandering in the arid wastes of Arizona, Mr. Smith went north into California and entered Death Valley, where it had been believed no man could live, and finally came upon traces of the borax that finally made him the "Borax King." In 1872,


Group of Mycalex parts and fittings

while prospecting for gold, his imagination first became really fired when, a few yards from the door of his camp, he saw the glistening white surface of a dried saline lake called Teel's Marsh. Convinced that the snowy substance was rich in chemical values, Mr. Smith took a specimen to an assayer in Columbus, Nevada, who pronounced it the finest grade of borax he had ever seen. Within two years Smith controlled the borax market of the United States.

... several years he sold out his interests only to return again to the borax fields when most of his original fortune had been lost. At the age of 75 he rode 80 miles on horseback to purchase a borax mine. —*A. E. B.*

Mycalex—A Unique Molding Material

SOME 15 years ago a young English chemist working in India in behalf of London mica interests became interested in the possibility of finding a use for the great quantities of scrap or waste mica left after preparing for the market the well-known white mica of India, says L. E. Barringer in the *General Electric Review*.

The "mica dump" of refuse mica is characteristic of all mica mines, since only a relatively small percentage of the mica rock taken from the mines is of commercial value. Furthermore, there is again a large percentage of scrap remaining from splitting, trimming, and cutting operations, and this secondary scrap is, of course, even more attractive for utilization than the mine scrap.

The chemist, Percy B. Crossley, conceived the idea of mixing ground mica scrap with an easily fusible glass, in powder form, heating briquettes of such a mixture to a temperature sufficient to soften the glass particles (about 675 degrees, Centigrade) and then molding the mass under hydraulic pressure while still hot and plastic.

With crude apparatus and unskilled Indian labor, Crossley produced plates of stone-like material up to 8½ inches by 11½ inches and in thickness up to three-fourths of an inch. These plates gave a clear, bell-like tone when struck with a piece of metal, thus indicating at once their comparative hardness and density. Crossley made tests which indicated that his material possessed to a high degree both mechanical strength and effectiveness as an electrical insulating material.

The combination of ground mica and soft glass was named "Mycalex" and is now being used to make a wide variety of electrical parts and fittings. Mycalex is an impervious, heat-resistant, inorganic material with which metal members may be combined in molding or subsequent casting, which is machinable and which possesses unusual insulation value, especially at radio frequencies. In addition, it possesses high compressive strength, high transverse strength, and resiliency.—*A. E. B.*

Arc-Welded Telescope Tube

FOR the first time the tube of a large astronomical reflecting telescope has been assembled by the arc welding process, instead of by the more familiar method of riveting. The skeleton structure shown in an illustration is the tube for the 69-inch telescope which is now being assembled at the Perkins Observatory of the Ohio Wesleyan University at Delaware, Ohio. It was welded by means of the stable ... process of the Lincoln Electric Company of Cleveland.

Rigidity is a definite requirement in structures of this nature, since the integrity of the optical image of a star depends in final analysis upon that quality. The tolerance in an example like the present one, where the tube has a length of 25 feet and a diameter of 90 inches, is only about ⅛ of an inch. (SCIENTIFIC AMERICAN, September, 1928, pp. 237-239.) In other words, a structure of this great bulk must be turned from a vertical to a horizontal position without suffering gr... than that amount at the outer end which carries the secondary mirror.

Readers will recall the favorable comment which was aroused in 1928 when the National Bureau of Standards succeeded in casting a 69-inch disk of high-grade glass. (SCIENTIFIC AMERICAN, February, 1928, page 158.) This disk, which has since been ground, polished, and figured (SCIENTIFIC AMERICAN, October, 1930, pp. 274-275) by J. W. Fecker of Pittsburgh, will be placed


The tube which is to hold the 69-inch Perkins Observatory telescope

in the tube shown in the illustration. The tube itself, and the other parts of the mounting, are the work of the Warner and Swasey Company of Cleveland. The pyramidal feature which shows in the illustration is a shutter which furnishes mechanical protection to the valuable mirror when the latter is not in actual use. It consists of eight metal triangular hinged leaves.—*A. G. I.*

New Mercury-Arc Rectifier

MERCURY, the ubiquitous friend of the chemist in his laboratory, is the secret of the efficiency of a mammoth rectifier, just introduced by the Westinghouse Electric and Manufacturing Company to convert alternating current to direct current. The most general use of this equipment is in supplying power for electric traction systems, although it has certain industrial applications. For some electrochemical processes, the power supply requirements are such that rectifiers provide the preferable means of conversion.

The new steel tank mercury-arc rectifier developed by Westinghouse

The operation of these rectifiers is based on the principle that in an ionized gas only a small positive potential with respect to the gas is required to cause current to flow to an electrode while a large negative potential can be applied before appreciable current flows. The rectifier consists of a mercury pool cathode and an anode inside a steel tank, with facilities for condensing the mercury vapor, and the necessary auxiliary apparatus for maintaining the vacuum and temperature conditions of the rectifier within the limits required for proper operation.—*A. E. B.*

New Sealing Compound

A NEWLY discovered micaceous mineral that is said to be a natural lubricant and a preserver of metal, and to possess the property of expanding to several times its normal volume when exposed to heat, has been made the base of a plastic sealing compound that retains all the characteristics of that mineral, says a recent issue of *Gas Age Record*. The product is called "Q-Seal", and has been put on the market by the Quigley Company, Inc., of New York.

After the mineral has been ground to a fine powder, it is mixed with other ingredients, the principal one of which is non-corrosive, and impervious to crude oils and their derivatives, to acids, gas, steam, ammonia, brine, vapor, creosote, tar, and air. Q-Seal is easily applied with a brush. In addition to making joints leakproof and preventing rust and corrosion, the manufacturer claims that the compound will fill any imperfections in threads, flanges, and gaskets owing to its inherent tendency to expand.—*A. E. B.*

Frozen Pulp Retains True Fruit Flavor

EXPERIMENTS in the food research division of the Bureau of Chemistry and Soils, United States Department of Agriculture, have developed a new type of frozen fruit pulp which promises a new outlet for the fruit grower and packer, a new fruit base for the ice-cream manufacturer and soda-fountain operator, and a new product for direct consumption in the frozen state. By pulping the pitted fruit, adding a sugar sirup of proper concentration, mixing it thoroughly, and then freezing at very low temperatures, chemists have developed a product with a remarkably smooth texture and full retention of the original flavor. Experiments have included peaches, apricots, plums, cherries, pears, raspberries, and strawberries.—*A. E. B.*

Nickel Safe for Three Milk Vitamins

THE vitamins in milk are unaffected by nickel, according to a study made by Avery D. Pratt of the Department of Vital Economics, University of Rochester, which has been published in *The Journal of Nutrition*.

"Since nickel is being used more extensively in industrial machinery and especially in dairy manufacturing equipment," he said in explaining the reason for the study, "it seemed important to investigate the possibility that it might act as a catalyzer in the destruction of vitamins during the pasteurization of milk. If only a comparatively small percentage of the vitamin content of milk or other foods was destroyed by such a catalysis, this would in the aggregate be of very great importance in human nutrition."

The results of the study showed that:

"There was no appreciable destruction of vitamin A by pasteurization in either a glass or a nickel container.

"The antineuritic factor of the vitamin B complex was partially destroyed by pasteurization but there was no evidence of a catalysis of the destruction by nickel.

"Vitamin C was partially destroyed by pasteurization but nickel did not seem to increase the destruction.

"Unless it can be demonstrated that nickel itself is beneficial to animals on vitamin deficiency diets, it is impossible to interpret the data as indicating any catalytic destruction of vitamins A, B, or C by nickel during pasteurization."

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—*The Editor.*

Radio Tube Suits Settled

COMPLETE stabilization of the radio tube industry of the country was presaged with the recent announcement by David Sarnoff, president of the Radio Corporation of America; C. G. Munn, president of the De Forest Radio Company, and repre- [illegible] tube makers, of the a[illegible]cable settlement of the controversy which has been waged for years over vacuum tube patents.

The terms of the settlement, Mr. Munn announced, included the payment by the Radio Corporation to the De Forest company of 1,000,000 dollars in cash. "Cross license agreements on tube patents only have been entered into by both companies," he said, and these agreements affect 20 other manufacturing concerns as well.

The understanding reached settles all anti-trust law suits instituted against the RCA by vacuum tube makers who were not operating under license of the patents of the Radio Corporation. It covers all triple-damage actions brought against the RCA for alleged violation of the Clayton act, by reason of the so-called Clause 9 effective in 1927 and 1928 in the licensing agreement between radio set manufacturers and the Radio Corporation. The suits, brought from time to time against the RCA by the independent tube makers, are said to have involved demanded damages of more than 47,000,000 dollars.

Twenty companies, besides the De Forest organization, have been joined in the understanding with the Radio Corporation. They are the Arcturus Radio Tube Company of Newark, Mellotron Tube Company, Vesta Battery Company, Van Horne Company, Schickerling Products Corporation, Gold Seal Electric Company, Universal Electrical Lamp Company, Republic Radio Tube Company, Mutual Electric Lamp Company, Continental Corporation, Sunlight Lamp Company, Marvin Radio Tube Corporation, Radex Corporation, Globe Electric Company, Duratron Radio Tube Corporation, Gold Seal Manufacturing Corporation, Supertron Manufacturing Company, Cleartron Vacuum Tube Company, Diamond Radio Tube Company and Poughkeepsie Gold Seal Company.

The terms of the understanding also include the acquisition of licenses under RCA patents by the active tube companies, including De Forest, Gold Seal Electric Company, Arcturus, Republic Radio Tube Company and Diamond Radio Tube Company. In the same understanding, the RCA and licensed concerns acquired tube-making rights under the patents held by the De Forest company.

It was stated by Mr. Munn that:

"The De Forest Radio Company, after 25 years of pioneering in the development of the radio tube and radio communication arts, has finally been accorded its proper place in the present-day industry by virtue of recent court decisions and the present settlement. It is now in an exceptionally strong financial position not only for the production of receiving tubes, transmitting tubes, amplifying systems, transmitters, television equipment, and other products, but for the furtherance of its extensive research and engineering program. The organization can now devote the necessary efforts required in bringing about an early realization of popular television through its subsidiary company, the Jenkins Television Corporation.

"The radio public gains by this settlement through having the radio industry concentrate once more on the development and production of new and better radio products, in place of the long litigation which has severely strained the resources and attentions of the contestants during the last few years."

Mr. Sarnoff said: "In a number of instances patent infringement suits brought by the Radio Corporation of America have been pending against companies seeking damages in the Clause 9 cases. The active manufacturing companies that are parties to the settlement have recognized patent rights of RCA by acquiring licenses under its patents, and these patent infringement suits will be dropped. The Radio Corporation of America has also obtained rights for use both by itself and its tube licensees under radio tube patents owned by the De Forest Radio Company.

"The termination of this large number of suits, on terms satisfactory to all parties involved, will do much to free the radio industry from litigation with which it has been burdened and impeded for several years, and which entailed heavy expense to all concerned. It will enable the industry to devote more of its attention to the development of new products and new services for the public and should have a stimulating effect on business as a whole."

Clause 9 of the RCA licensing agreement, which was the basic cause of the litigation, was in effect during part of 1927 and 1928. Under it, set makers licensed by the RCA were required to see that their sets were equipped with RCA tubes when first sold. This resulted in litigation between the De Forest company and the RCA to test the validity of the clause. The Federal Court in Delaware and the United States Circuit Court of the Third District held in favor of De Forest company. The RCA then applied for a writ of certiorari, but the United States Supreme Court declined to review the decision. The suits settled by the agreement just announced were based on the same clause in the former licensing contract with broadcast set makers.

The announcement reported above may be followed by a compromise of the government's anti-trust suit against RCA and affiliated companies, involving alleged patent pools.

Officials at the Department of Justice said that negotiations would be resumed between government and RCA counsel to determine what action would be taken.

The suit against the Radio Corporation followed several years of investigation by the Department of Justice and the Federal Trade Commission. The suggestion was made last summer that a patent pool be formed to administer the patents held by the Radio Corporation and affiliated corporations. Through these patents it has been alleged that the Radio Corporation monopolized the radio manufacturing industry.

"Developing" Cream Advertised As a Body Builder

THE vendor of a cream alleged to ha the power to fill out and develop t neck, arms, busts, legs, and other parts the human body, having been charged w... publishing false and misleading advertisements in the sale of this cream, signed a stipulation, with the Federal Trade Commission in which he admits that the cream is primarily a lubricant. If any development results from use of the preparation it would be due to the massage recommended rather than to the cream, according to the terms of the stipulation.

The vendor agreed to discontinue publishing the misleading statements, particularly the following: That he has made research or experiment or incurred a large expense in developing the cream or the health instructions sold with it; that mere application of the cream will develop a beautiful, well-rounded bust, eliminate the hollows from the neck, round out the arms, develop the legs, or beautify the complexion; and that he is in possession of body beautifying secrets.

The vendor also agreed to discontinue using the word "studio" as part of his trade name, unless and until he actually maintains a studio for the teaching and practice of beauty culture.

"Kanetex" Refused Registration

IN the case of The Celotex Company versus John H. Mitchell, Assistant Commissioner Moore held that John H. Mitchell, of Chicago, Illinois, is not entitled to register, as a trademark for wall board and thermal insulation, the term "Kanetex" in view of the prior adoption and use by The Celotex Company, of Chicago, Illinois, of the term "Celotex" as a trademark for the same class of goods.

In his decision, after referring to certain decisions of the Court of Customs and Patent Appeals in which the marks "Flametex," "Opal-Tex," and "Fir-Tex" were respec-

tively held confusingly similar to "Celotex," the Assistant Commissioner said:

"There is no greater distinction between the applicant's mark 'Kanetex' and the opposer's mark 'Celotex' than there is between the marks involved in each of the above decided cases, and I am of the opinion that said decisions of the Court of Customs and Patent Appeals are controlling in the instant case."

Mexico is Largest Airplane Market

MEXICO led the nations of the world as a market for airplanes, airplane engines, and parts of United States manufacture during the month of May, according to figures made public by the Department of Commerce.

The United States' southern neighbor during the month took three airplanes totaling in value 91,237 dollars, one engine valued at 7800 dollars, and parts of a total value of 2872 dollars.

In addition to sales to this country, The Netherlands took two planes, valued at 5266 dollars, the United Kingdom one, valued at 60,349 dollars, and the Philippines one, valued at 5050 dollars. Sales of 18 engines, valued at 77,957 dollars were distributed among nine countries: Belgium, Canada, Guatemala, Panama, Mexico, Trinidad and Tobago, Brazil, Colombia, and Peru, while sales of parts totaling 87,438 dollars were distributed among 28 countries.

In addition to these sales to foreign countries, parts valued at 1223 dollars were shipped to Hawaii, and Porto Rico received two engines, valued at 11,208 dollars, and parts valued at 28 dollars.

Motion Picture Screen Patent Claim Allowed

THE primary examiner of the Patent Office rejected claim 6 in patent No. 1819776. Applicant appealed to the Patent Office Board of Appeals, and Examiner-in-Chief Thurber handed down a decision in favor of applicant. The following claim was the one rejected, but finally allowed on appeal:

"6. A moving-picture screen adapted for coordinated sound transmission, composed solely of a single-thickness finely-woven textile-fabric screen having a front light-reflecting surface to receive the projected picture and provided with perforations therethrough in number and size sufficient to permit passage of sound-waves therethrough of appropriate volume without blurring, while at the same time preserving the light-reflecting properties of such surface sufficiently to constitute an efficient screen for the presentation of the pictures, the walls of said perforations being at substantially right-angles to the body of the screen."

The references relied on are: Amet, 1308-468, July 1, 1919; De Forest, 1710922, April 30, 1929.

This application relates to a moving picture screen provided with small perforations so that the sound reproducing apparatus may be located behind the screen and the sound pass through the perforations.

It was old to perforate a screen as shown by De Forest but De Forest thought that it was necessary to place an additional screen in the rear of the picture screen in order properly to reflect the picture. Amet employed a single wire screen but he considered that it was necessary to provide peculiarly cup-shaped reflectors provided with holes in their bottoms.

We have no evidence, therefore, that anyone prior to appellant realized that it would be practical to place small parallel sided holes in a single screen and by proper selection of the size and number of the holes permit the sound to pass through without disturbance while at the same time permit the picture to be reflected properly. The examiner states that appellant has done nothing more than omit the secondary screen of De Forest but we find nothing to indicate that the size and number of the openings in the De Forest screen are such that the front screen could be used without the rear one nor do we regard the omission of the rear screen as obvious. We also do not agree with the examiner in his statement that Amet anticipates the claim except for the material. The claim specifies perforations at right angles to the bottom of the screen. Amet clearly specifies cup-shaped openings with holes at their bottoms. In the absence, therefore, of any suggestion that a simple screen of the nature disclosed in this application could be employed for the dual purpose it is considered that the subject matter of the claim is not properly anticipated.

The decision of the examiner is reversed.

Oil-Sand Process Patent Claims Valid

AN appeal from the action of the examiner by the holder of a patent covering a method of recovering oil from oil sands was decided in favor of the patentee. The examiner had rejected claims 1 to 6 of which claims 1 and 6 may be considered as typical.

"1. Process of recovering oil from oil sands in situ which comprises flowing therethrough an aqueous liquid comprising a highly dispersed colloid material which is physically and chemically stable in the presence of said sands."

"6. Process of recovering oil from oil sands in situ which comprises flowing therethrough an aqueous liquid comprising a highly dispersed colloid material including a hydrocarbon sulfonate which will not form a precipitate when mixed with water that has been in contact with said sands."

The references relied on by the examiner are: Squires, 1238355, Aug. 28, 1917, Rogers, 1299385, April 1, 1919, Fyleman (Brit.), 163519, May 26, 1921, Barnickel, 1555818, Oct. 6, 1925.

The decision of the Patent Office Board of Patent Appeals follows in part:

The claims relate to a method of recovering oil from oil sands in situ and is for use with such sands as are spent in-so-far as substantial oil recovery by flowing and pumping is concerned. The method involves introducing into the sands a material in water solution which tends to liberate such oil as surrounds the individual grains of sand in the oil bearing stratum. The material used is broadly defined as a dispersed colloid material which is physically and chemically stable in the presence of said sands, in other words a material which will not unite with chemical substances found in the sand such as compounds of lime and magnesia to form an insoluble substance which would tend to clog the sand and thus prevent further oil recovery.

In our opinion, none of the references clearly teach appellant's basic method. The Squires patent relied on by the examiner introduces water into the oil stratum to displace the oil therein to a higher level in the stratum where it may be moved toward a well by air or gas pressure or picked up in vapor form by the same gaseous medium. As we read the patent Squires sought to displace free oil from pockets and had no thought of recovering such oil as was in emulsifying relation to the sand. Mention is made of using alkali with the water and also of using heat but this may well have been intended to increase the fluidity of the heavy free oil. At any rate there is no mention of effecting appellant's specific purpose.

The British patent to Fyleman broadly suggests in the provisional specification that his process is applicable to the treatment of sand or rock in situ. But in the complete specification no definite mention is made of such treatment. It is pointed out on behalf of appellant that many, if not all, of the substances proposed by Fyleman do not meet the requirement of physical and chemical stability which he considers essential to the practical working of his process and that therefore Fyleman had no real conception of a solution of the problem. With this contention we are constrained to agree.

The use of materials such as suggested by Rogers or Barnickel in the manner vaguely suggested by Fyleman would doubtless meet the claims but in our opinion this involves something more than a mere substitution of equivalents. Appellant by the substitution has converted an unpractical suggestion into a practical and meritorious advance in the art and in our opinion is entitled to the corresponding protection involved in the appealed claims.

The decision of the examiner is reversed.

Air School Name Censored

A WASHINGTON, D. C. correspondence school, Aviation Institute of U. S. A. Inc., giving instruction in aviation, has been ordered by the Federal Trade Commission to stop using as a part of its trade name the letters "U.S.A." or other letters, words, or insignia in ways that would indicate affiliation with the United States Army, Navy, or some department of the Government; or that its course is conducted according to government requir

The Commission found that use of the letters "U. S. A." both in trade and corporate names, and of the address "Washington, D. C.", and of the title "Lieutenant" in referring to the school's president, as well as a general use of insignia consisting of wings separated by a shield in its advertising literature, has a tendency to deceive the public, and to cause many to enroll as students under the erroneous belief that the school is officially connected with the Army, Navy, or some government department, and that its instruction is conducted in accordance with government requirements, and that because of such supposed official connections this school is in better position to give instruction than competing institutions teaching the art of aviation by correspondence.

Books SELECTED BY THE EDITORS

THE PHYSICS OF HIGH PRESSURE

By P. W. Bridgman, Prof. Physics, Harvard

FOR years the physicist Bridgman has been performing unusual research on matter at exceedingly high pressures (see article "Stupendous Pressures," in SCIENTIFIC AMERICAN, July, 1927, in which the same author describes work at pressures of 600,000 pounds per square inch). Now he has put together in a book the findings of all his investigations of the properties of solids, liquids and gases at these stupendous pressures. Heretofore there has been *no* book on this subject. Now there is—one of 387 text pages. Part of the text is somewhat abstruse, but a large part is graspable by others than physicists. The interesting technique is described.—$5.70 postpaid.—*A. G. I.*

TEXTBOOK ON SPHERICAL ASTRONOMY

By W. M. Smart, D.Sc., Astronomer, Cambridge Observatory

AMATEUR astronomers with mathematical leanings will revel in this new book which fills a gap that has previously been but poorly filled. It covers in separate chapters: spherical "trig," the celestial sphere, refraction, the meridian circle, planetary motions, time, heliographic coordinates, aberration, parallax, precession and nutation, proper motions, astronomical photography, navigation, binary star orbits, occultations and eclipses, and is almost wholly mathematical; 408 pages.—$7.20 postpaid.—*A. G. I.*

THE UNIVERSE IN THE LIGHT OF MODERN PHYSICS

By Dr. Max Planck, Prof. Phys. Univ. Berlin

THIS is a short 114-page series of semi-popular lectures on various aspects of the new physics, by the famous discoverer of "Planck's Constant," who is perhaps the greatest living physicist, next to Einstein. Physicists will find them easy reading; serious amateur readers of physics will readily follow their implications; while those who do not possess a familiarity with the concepts of the newer physics will be likely to flounder if not founder.—$2.15 postpaid.—*A. G. I.*

THE STRUCTURE OF CRYSTALS

By Ralph W. G. Wyckoff

FOR the past few years there has been no up-to-date book on this subject, the X-ray analysis of crystalline matter. In this second edition of an earlier work which was enthusiastically received by men of science, the author, a well-known authority on his subject, brings it up-to-date. It is fair to prospective purchasers to state that this book is not elementary; it presupposes a knowledge of chemistry and crystallography.—$7.50 postpaid.—*A. G. I.*

AIR NAVIGATION

By P. V. H. Weems, Lieut. Commander U. S. N.

DISTINCTLY a text-book for the practical air navigator, this covers pilotage or map reading, dead reckoning, aerology, radio position finding and celestial navigation. The discussion of the last subject includes a description of the new efficient and novel method and equipment which Gatty used in his 'round the world flight. Commander Weems gives Gatty credit for help in compiling this book particularly on the "Star Altitude Curves."

This is probably the most important book on this subject that has been issued. 589 pages with a complete bibliography. Flexible binding.—$5.20 postpaid.

THE HANDY MAN'S HANDBOOK

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SECONDARY ALUMINUM

By Robert J. Anderson, D.Sc.

THIS represents the boiled-down results of many years of practical experience and systematic study by the author in the diversified aluminum field.

It covers the metallurgy, technology, raw materials, production, economics and utilization of secondary and scrap metal; a balanced blending of theory, plant operation and commercial practice. A real meaty book of 563 pages, produced in most excellent format with extensive bibliography following each chapter. Though a studious work of importance, Dr. Anderson's style makes very easy reading; a treatise long needed by manufacturer and consumer. Obtain from Sherwood Press, Cleveland, Ohio.—$10.25 postpaid.

THE INSECT MENACE

By Dr. L. O. Howard, Former Chief Entomologist U. S. Dept. of Agriculture

NO one can speak with greater authority for surely no one has a more solid background than this world-known scientist. Here he paints a just and alarming picture of what would happen if insects were left to themselves with a much greater chance of survival than man! Then he shows how the world is slowly awakening to the gravity of this menace and describes the growing use of man's defensive weapons; chemicals, airplanes, quarantines, and variations in crop practices. An important, authoritative, and most interesting contribution to the bibliography of entomology.—$3.65 postpaid.

THE LUNGS AND THE EARLY STAGES OF TUBERCULOSIS

By Lawrason Brown, M.D. and Fred H. Heise, M.D.

FOR those who have tuberculosis or fear they may acquire it, or who for any other reason are interested in it as laymen, this book contains just the right dosage of technical fact—just the facts an intelligent layman would be likely to wish he knew and might ask a doctor. The authors are staff physicians at the famous Trudeau Sanatorium for tubercular patients, possibly the foremost institution of its kind in this country. This book may safely be regarded by persons interested in its subject as a rare find, when the fact is considered that few doctors have been so frank, open, direct, and informative.—$1.65 postpaid.—*A. G. I.*

GANDHI AT WORK

Charles F. Andrews, Ed.

THIS is the second of three books giving a close narrative of the life and activities of Gandhi, being a record of his work and teaching in South Africa. Here were laid the foundations which eventually produced one of the most picturesque leaders of history—respected and admired by all the great men of the world, with a considerable number of whom he has close acquaintance. It is a picture vastly different from that one would readily form from the news, and one well worth intimate study if one is to appreciate fully why he is now India's recognized leader.—$2.65 postpaid.

MEXICO—A STUDY OF TWO AMERICAS

By Stuart Chase

WITH his particular charm of narration the author takes one by devious trails and side excursions through a wide variety of interesting country pregnant with the sleepy characteristics of those who have lived for generations under a punishing sun. Frankly he is charmed by Mexico and even the splendor of the once buried cities of Yucatan does not win him away. You will get quite a different picture of these countries than you have had before—one that contains interesting facts not generally appreciated.—$3.20 postpaid.

THE EPIC OF AMERICA

By James Truslow Adams

IN the author's own words "he has desired . . . to paint a picture, with broad strokes of the brush, of the variegated past which has made our national story and at the same time discover . . . how the ordinary American . . . has become what he is today in outlook, character and opinion." So ably has this distinguished historian concluded his work, competent critics pronounce this the best single volume on American History in existence. 6½ x 9½, 433 pages with extended index and chapter heading woodcuts.—$3.20 postpaid.

HOW OUR GOVERNMENT IS RUN

By Inez N. McFee

ALTHOUGH announced as a book for young citizens, we find it so orderly and well developed that it is unhesitatingly recommended for adults as well. You will be surprised at the amount of information about our government one should know which here is read almost as new material. A splendid book for a Christmas present.—$2.65 postpaid.

THE PACIFIC

By Stanley Rogers

BY the same author who wrote that most entertaining book "The Atlantic." Stories about voyagers and voyaging, enchanting islands, buccaneering, dusky people with characteristic customs—all the glamor and romance of the Pacific of yore. Intermingled throughout this most readable series of descriptions are a surprising number of interesting facts one fails to have been impressed with before, many, doubtless, the keen observations of one who himself served before the mast in an old windjammer. You will enjoy and be considerably informed by reading this profusely illustrated work.—$2.90 postpaid.

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By A. C. Edgerton

THIS book is unusual in that the speeches cover every sort of occasion, are well composed, and the whole is of much higher class than anything we have seen. Even should they not be used in entirety, many helpful, appropriate suggestions will be found.—$2.15 postpaid.

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By H. M. Lydenberg and John Archer of the N. Y. Public Library

FOR the book collector or librarian, a practical summing up of the best current ideas as to how to repair book-pages, plates and bindings. Detailed instructions for the care and repair of books naturally covers some enemies of books, repair and mending, treatment of paper, vellum, the care of leather bindings and the treatment of cloth. All the necessary tools and accessories are illustrated and the directions are simple, clear and conclusive. A book every library should have.—$2.15 postpaid.

THE TEN COMMANDMENTS

By *Warwick Deeping*

NOW and then one finds a book which does not contain extended analysis of the psychology of a situation, sex, or sentiment but relies on inherent beauty either of character or setting—always looking for the pleasant and the worthwhile. Such is this one. Frequently the expansion of a thought borders on preachiness—but good taste is ever predominant and the author never crosses the line. A clean uplifting, entertaining story told with characteristic fluency and readiness of expression. It makes one feel good to read such a wholesome book.—$2.50 postpaid.

YOUNG MASTERS OF MUSIC

By Mary Newland Roberts

HERE is another fine book for a Christmas gift. It is very well put together and the illustrations are particularly well done, as is the binding. We are so accustomed to thinking of the great composers merely as stately figures on a pedestal, that they cease to be human beings. In this author's approach one gets a different and far more interesting acquaintance with these youths of the long ago, than the conventional one. They become more real personages under her dramatic touch.—$2.65 postpaid.

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By Lee S. Crandall

A NATURALIST'S adventures in New Guinea seeking the rare and beautiful birds of paradise and traversing tropical jungles listening to and seeing strange and magnificent birds while observing the life of man and beast. This simple narrative of observation carries one along irresistibly, its details so sharp and clear, all seem like virgin material. An interesting story well told. —$3.65 postpaid.

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By Ellison Hawks

BEGINNING with the first crude efforts of man to conquer space with beasts of burden, then sledges, wheeled vehicles, stage-wagons, and coaches, the story develops the use of Roman roads to modern, then considers railways, mechanical road transport, ocean travel, and airship convenience of today. A well rounded consideration, illustrated with most interesting photographs and drawings.—$3.20 postpaid.

SPEECH PATHOLOGY

By L. E. Travis, Prof. Psychology, University of Iowa

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DECEMBER · 1931

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Western Advertising Representative Los Angeles San Francisco Seattle and Atlanta

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